

North Carolina Weatherization Installation Standard Work Specifications



VERSION 1.1

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SUMMARY OF CHANGES SINCE VERSION 1.2B

- 1) 1400: Section added to explain the Standard Work Specification.
- 2) 1800-1830: These sections on monitoring have been moved to the NC Weatherization Program and Budget Guidance and the remaining sections renumbered.
- 3) 2110: The section on Accountable Results for Community has been moved to the NC Weatherization Program and Budget Guidance and the remaining sections renumbered. Updated guidance in current section so that the Weatherization Assistant can be used to make comparisons to Manual J's, but cannot be used in place of them.
- 4) 2230: The section on Client Education has been moved to Section 4000.
- 5) 2610: The section on Warranty Documentation and Operating Manuals has been moved to 2470.
- 6) 3000: Gates County has been added to the list of coastal counties.
- 7) 5200: Termite infestation removal is now an allowable item to align with the Standard Work Specification (SWS).
- 8) 5621: Update requirements so that multiple CO alarms shall be installed if there are multiple sleeping areas in a dwelling.
- 9) 5631: Updates requirements so that multiple smoke alarms shall be required in dwellings.
- 10) 5410: This section on Air Pollutants has been removed and its contents split over several sections
- 11) 5640: Revises policy on aluminum wiring in allowing COPALUM repair to be used.
- 12) 5660: Updates requirements to allow for EPA approved test kits.
- 13) 5720: Updates requirements to increase dryer vent maximum length to 35 ft. and to require venting outside the conditioned space to be insulated to align with the SWS.
- 14) 5730: Updated vapor barrier policy to align with the SWS. Require overlap has been increased from 6 inches to 12 inches, requirement to air seal and mechanically fasten vapor barrier to crawl space piers and foundations walls has been removed, and clarifies that the vapor barrier must be installed last.
- 15) 5810: ASHRAE 62.2 has been updated to 2013. Venting exhaust fans through gable vents shall allowable when a termination fitting is used. Maximum sone rating for installed kitchen fans shall be 3.0.
- 16) 5900: Health and Safety Policy has been moved to the NC Weatherization Program and Budget Guidance.
- 17) 5910: This section on Prohibition of Smoking and Tobacco Use has been moved to 2460.
- 18) 6230: The target total duct leakage of 12 cfm per 100 square feet for duct blaster has been established.
- 19) 6500: The ambient CO concentration has been increased to 35 parts per million to align with the Building Performance Institute (BPI) and the SWS. The Allowable Draft Chart has been revised to align with the SWS. Unconditioned attics, crawl spaces, and basements are excluded from CAZ testing. CAZ Depressurization limits have been revised to align with the BPI.
- 20) 6510: This section has been expanded to include additional combustion appliances.
- 21) 7200: Clarification that supplemental heat sources do not need to be evaluated by a licensed HVAC contractor.
- 22) 7410: Air filter for new central systems must be rated MERV 6.
- 23) 7430: This section has been expanded to include refrigerant line testing.
- 24) 7460: This section has been revised to cover airflow analysis.
- 25) 7610: Wood Stove efficiencies have been added.
- 26) 7700: A low nitrogen oxide burner will be required for combustion water heaters.
- 27) 8100: The spacing between support straps for air ducts have been reduced from 5 ft. to 4 ft. to align with the SWS.
- 28) 8200: The requirements on how to seal gaps in duct systems have been revised to match SWS.
- 29) 8410: This section has been added to give guidance on removing vents from areas outside the defined conditioned space.
- 30) 9250: Storm windows are allowable on site built dwellings when cost justified in NEAT.

- 31) 9260: Clarification that untreated wood shall be primed and not left untreated.
- 32) 10140: Updates requirement of attic hatch to match the R-value of the surrounding insulation and not be composed of compressible (i.e. fiberglass) insulation.
- 33) 10200: Clarification that sidewall insulation shall be installed in homes with brick cladding.
- 34) 10300: Gates County has been added to the list of coastal counties.
- 35) 11200: This section has been renamed and LEDs have been added as lighting update option. Clarification that only CFL's that are rated for ceiling fans or dimmer switches shall be installed in with those fixtures.
- 36) 11300: Clearance from pipe insulation to gas vent has changed to 3 inches and the required length of water heater pipe insulation has been increased from 5 ft. to 6 ft. to align with the SWS.
- 37) 25130: Clarification on commissioning and de-commissioning existing exhaust fans has been added to the manufactured home section to align with the SWS.
- 38) 25140: This section has been updated to reflect the use of lead in varnishes and stains in remodeled manufactured homes before 1978.
- 39) 30100: Clarification that ventilation in mobile homes must be maintained and shall not be blocked by insulation.

Standard Work Specification Single Family Crosswalk

SWS Section	Installation Standards Section
2.0100.1a-b;j;m	5540
2.0100.1c	5420
2.0100.1d	5640
2.0100.1e	5620
2.0100.1n	5630
2.0100.1o	5650
2.0100.1p	5660
2.0104.1	10110
2.0105.1	5610
2.0105.2a	7920
2.0105.2b	7930
2.0105.2c	5650
2.0105.2d	7430
2.0105.4b	7920
2.0105.4c	5650
2.0110.1	5540
2.0111.2	10320
2.0111.2a	5610
2.0111.2b	5640
2.0111.2c	5710
2.0111.2d	9200
2.0111.2e	5200
2.0111.3	5510
2.0201.1	5610
2.0201.1c	6500
2.0201.1d-8	6500
2.0201.2c	5621
2.0201.2e	6520
2.0201.2f-g	6520
2.0202.1	7330
2.0203.1	6500
2.0299.1	6500
2.0301.1b	5631
2.0301.2b	5621
2.0401.1a	5710
2.0401.1b;c	5730
2.0401.1c	5710
2.0401.1d	5740
2.0402.1d	5730
2.0601.1	5640
2.0701.1	9200

SWS Section	Installation Standards Section
2.0701.2	9300
2.0702.a	2470
2.100.1f-h;j;k-l	5550
2.103.1a	9100
2.2023.2	6510
3.1001.1	9400
3.1001.3	10220
3.1002.1-3	9400
3.1003.1-3	9400
3.1003.6	9400
3.1004.1	9400
3.1005.1	9400
3.1201.1-2	9261
3.1201.3	9271
3.1201.4	9261
3.1202.2	9261
3.1203.1-2	9261
3.1401.1	9300
3.1402.1	9300
3.1501.1	9300
3.1601.1	8100
3.1601.3a	8100
3.1602.1	8200
3.1602.4	8200
3.1602.7	8400
4.1001.1	10120
4.1001.2	5640
4.1001.3	10120
4.1001.4a	10120
4.1003.1	10150
4.1003.1	10160
4.1003.4	10150
4.1003.4	10160
4.1005.2	10130
4.1006.1	10140
4.1006.2	10140
4.1006.3	10120
4.1088.3	10120
4.1101.1	10230
4.1102.1	10220

SWS Section	Installation Standards Section
4.1103.2	10220
4.1301.1	10330
4.1301.5	10330
4.1301.6	10330
4.1402.2	10330
4.1601.2	8300
4.9901.1	9100
5.3001.1	7620
5.3002.1	7600
5.3002.1	7620
5.3003.10	7410
5.3003.2	6510
5.3003.3	7460
5.3003.3h	7400
5.3003.4	7420
5.3003.5	7430
5.3003.6a	7410
5.3003.7	4000
5.3003.9a	7920
5.3003.9b-d	7410
5.3003.1a	7600
5.301.1	8300
5.3101.1	7620
5.3104.1-3	7410
6.6002.1-2	5810
6.6002.3	5810
6.6003.1	5810
6.6003.3	5810
6.6004.2	5800
6.6005.1	5720
6.6188.1	8410
6.6201.1c	5810
6.6201.2a	6300
6.6202.1-2	5810
6.6288.1	5810
7.8001.1	11100
7.8003.1	11200
7.8101.1	11310
7.8102.1-2	7700
7.8103.1	11300

North Carolina Weatherization Installation Standards

Standard Work Specifications

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1000 General Programmatic Guidance

1100 Scope

The mission of the North Carolina Weatherization Assistance Program (NC WAP) is to improve residential energy efficiency and energy-related health & safety conditions and to educate the public about ways to implement and enhance energy conservation strategies. The weatherization program focuses on serving the elderly, disabled, families with children, and heavily energy-burdened households. The goal of NC WAP is to keep North Carolina residents warm in the winter, cool in the summer, and safe all year long.

The State of North Carolina administers both NC WAP and the Heating and Air Repair and Replacement Program (HARRP) on behalf of the federal Department of Energy (DOE) and Department of Health and Human Services (DHHS). As a *grantee* responsible for administration of these federal programs, NC WAP contracts with local weatherization service providers who, as *Subgrantees*, shall be responsible for compliant implementation of program objectives.

The North Carolina Weatherization Installation Standards have been aligned with the National Renewable Energy Laboratory's (NREL) Standard Work Specifications (SWS) and shall govern installation procedures for all weatherization service providers, their representatives, and designees responsible for providing weatherization program services. The Installation Standards shall be divided into major sections as follows:

- 1) General Guidance and Site Built, Single Family Dwelling Section
- 2) Manufactured Home Section
- 3) Multifamily Section

Questions concerning the content, interpretation, or implementation of the Installation Standards shall be directed to NC WAP.

1200 Effective Date

The effective date for implementation and enforcement of these Installation Standards shall be specified in one attached cover page. All weatherization measures installed or performed by weatherization service providers on or after the effective date(s) specified shall comply with these Installation Standards. Prior versions of the Installation Standards shall be considered null and void.

1300 Amendment of Standards

From time to time the Installation Standards may be amended to reflect changes in state or federal law, technology, or general industry experience and best practices.

Amendments to the Installation Standards shall take effect 30 days from the date of written notification to weatherization service provider unless otherwise indicated. Changes in federal, state law, or DOE guidance may necessitate amendments be made effective immediately upon written notification.

1400 Using the Standard Work Specifications

The SWS identify and define the desired outcome(s) of a particular energy efficiency measure, stated as objectives, and then list the minimum specifications needed to meet those outcomes, as shown below in the example below.

4.1006.1 Pull-Down Stairs
Topic: Attics
Subtopic: Attic Openings
4.1006.1 Detail Name: Pull-Down Stairs
Desired Outcome: Pull-down attic stair properly sealed and insulated

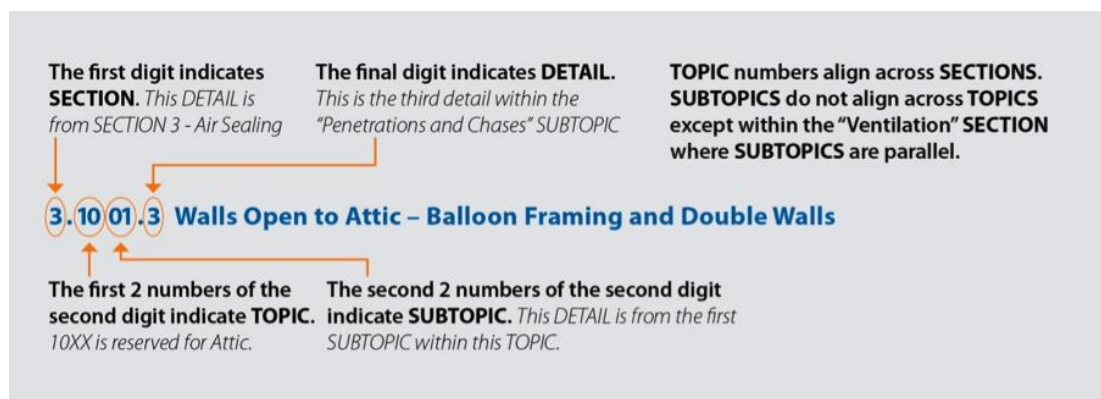
ROW	TITLE	SPECIFICATION(S)	OBJECTIVE(S)
4.1006.1a	Installation	Hatches will be insulated with non-compressible insulation and the measure will include a protective barrier or baffle Pull down stair assembly will be insulated to the same R-value as the adjoining insulated assembly Pull down stair rough opening will be surrounded with a durable dam that is higher than the level of the attic floor insulation	Achieve uniform R-value Prevent loose insulation from entering the living area

The **Specification** defines the minimum level of action required to meet the **Objective**.

The **Objective** defines the required outcomes of the work.

1410 Numbering Scheme

The SWS are organized into four layers, reflecting how an individual may approach a whole-house assessment or audit. From general to specific, the layers are ordered by section, topic, subtopic, and detail, as shown in the graphic below. Each section contains multiple topics and each topic is further divided into subtopics and details. The same numbering system utilized in the printed document is also included in this online tool, as a quick way to find specific information.



1500 Code Compliance

Correction of preexisting code compliance issues is not an allowable cost other than where weatherization measures are being conducted. No provision in the Installation Standards shall be interpreted in a manner which abridges safety, health, environmental codes, or other local ordinances. All weatherization program services shall comply with applicable local building codes. Local codes more stringent than the Installation Standards shall be followed.

Applicable building, mechanical, electrical, plumbing, insulation, and other permits mandated by local or state code authorities shall be obtained by weatherization service providers either directly or via subcontractors performing the permitted work. Permits shall be obtained prior to commencement of work and copies shall be provided to dwelling owners upon request. Copies of each permit issued, and the associated **passing** final inspection reports shall be maintained in the job file. Actual permit and inspection fees shall be allowed as a materials expense and shall be reasonable and customary.

As local code requirements vary heavily between local jurisdictions, weatherization service providers shall take special care to ensure code requirements are understood and consistently complied with on a per-job basis.

1600 Exceptions to Standards

Deviations from the Installation Standards, except deviations required under applicable local code requirements, shall require written authorization from NC WAP. Deviations from the Installation Standards required under local code shall be well documented and supporting documentation shall be maintained in the job file.

Weatherization service providers shall be exempted from performance of a particular measure where a preexisting or technical condition exists which inhibits performance of a particular measure. All allowable exceptions shall be documented in the job file.

Where a dwelling owner or authorized agent of the owner refuses to authorize performance of a required weatherization measure or to allow a previously authorized measure to be completed, weatherization service providers shall determine if weatherization services can still be provided. The dwelling owner or authorized agent may refuse the installation of up to one energy efficiency measure located on the Priority List of Measures for Site-Built Dwellings; however, no measures below the measure refused may be performed. If measures below the refused measure need to be performed, a site specific computerized audit must be performed to justify those measures. A site specific computerized audit must be performed if a client refuses more than one measure. No weatherization work shall be performed if the client refuses any combustion remediation, Category A fan in a home with a combustion stove, or Category B fan. Baseload measures not included on the Priority List of Measures or directly tied to Health and Safety may be refused by the client without penalty. In all instances, refusal by the dwelling owner and the justification used to determine appropriate remaining measures to perform shall be documented in the job file.

Local weatherization service providers shall not avoid completing priority weatherization measures by "documenting away" the measure. Weatherization service providers shall never seek or promote refusal of a measure by a dwelling owner or legally authorized agent of the owner in an effort to deliberately avoid a weatherization measure.

1610 Prohibited Measures

Measures and materials not specifically prohibited herein shall not be assumed to be implicitly allowed, but rather weatherization service providers shall request prior written approval from NC WAP prior to performance of any measure or use of any material which falls outside the scope of weatherization services.

The following measures and materials shall be specifically prohibited from installation in all dwellings:

- A) Skirting or underpinning of crawl spaces
- B) Foundation vents, except to provide combustion air to combustion appliances
- C) Installation of zippered attic hatch tent kits.

1700 Re-Weatherization/Re-HARRP

Federal regulations permit the delivery of additional services to dwellings that previously were served before September 30, 1994. Dwellings weatherized or receiving HARRP services after September 30, 1994 may not receive additional services, unless the dwelling has been damaged by an act of God and prior state approval has been secured.

It is the responsibility of the weatherization service provider to ensure that a comprehensive record of previously served dwellings receiving either weatherization or HARRP (per county) is compiled, maintained, and updated regularly to ensure compliance with these guidelines. The status of each subject dwelling with regard to prior weatherization and HARRP at the dwelling shall be verified during the application process and during the energy audit initial inspection, and shall be documented in the job file.

A low priority shall be placed by weatherization service providers in selecting previously served dwellings to revisit. Written approval by NC WAP is required prior to a weatherization service provider rendering re-weatherization or HARRP on a dwelling that was served prior to September 30, 1994.

1800 Deferral of Service Based on Site Conditions

Certain health and safety conditions may exist which make weatherization of certain dwellings unfeasible. In such cases, work for eligible households shall be deferred until the conditions can be adequately mitigated or corrected entirely. Where such conditions exist, weatherization service providers shall notify the clients and attempt to resolve such issues as well as pursue reasonable alternatives on behalf of the client, including making referrals.

Conditions requiring that a dwelling to be placed on deferral status shall include, but shall not be limited to:

- A) The dwelling has been condemned or major dwelling mechanical systems have been "red tagged" by licensed subcontractor, local or state code enforcement officials, or utility providers.
- B) The dwelling structure or its mechanical systems, including electrical and plumbing, are in such a state of disrepair that failure is imminent and the conditions cannot be resolved within cost limitations.
- C) The primary heating system at the dwelling is nonfunctioning or is functioning improperly and is deemed unsafe and must be replaced, or major repairs are needed and there are insufficient resources available.

- D) Dangerous conditions exist due to high CO levels in combustion appliances which cannot be resolved within weatherization program guidelines.
- E) Moisture problems are so severe they cannot be resolved within program guidelines.
- F) Unsanitary conditions are present in the dwelling that may endanger the health and safety of dwelling occupants or weatherization personnel should weatherization work be performed.
- G) Household members report documented health conditions that prohibit the installation of insulation and other weatherization materials.
- H) Household members, guests, or pets maintained at the dwelling are uncooperative, abusive, or threatening to weatherization staff or contractors.
- I) The extent and condition of lead-based paint or similar hazards in the dwelling may potentially create health and safety risks if weatherization work is performed.
- J) Illegal activities are being conducted in the dwelling unit.
- K) The dwelling has a dryer that cannot be vented to the outdoors.

1900 Enforcement

Inability or refusal by weatherization service providers to comply with any of the guidelines set forth by the Installation Standards shall result in administrative action by NC WAP including, but not limited in extreme instances to, termination of the weatherization service provider's award to provide weatherization services.

2000 Workflow Documentation

2100 General Documentation Tools and Methods

2110 Weatherization Assistant Energy Audit Software

The Weatherization Assistant (WA) energy audit software was developed by the Oak Ridge National Laboratory specifically for use by WAP. There are two components to the WA software, the National Energy Audit Tool (NEAT) for site-built dwellings and the Mobile Home Energy Audit (MHEA) for manufactured dwellings.

Use of the WA software shall be required wherever proposed weatherization measures deviate from NC WAP Priority List of Measures or where measure specific cost-justification is mandated to ensure that the proposed scope of work complies with WAP cost-effectiveness guidelines requiring a measure-specific and/or cumulative project savings to investment ratio (SIR) of 1.0 or greater.

Measures requiring the use of the WA software shall include, but not be limited to:

- A) Incidental repairs lacking a direct relationship to priority list measures, including replacing windows or doors
- B) Comparing heating, ventilating, and cooling (HVAC) system sizing for replacements to Manual J calculations.
- C) HVAC sizing for system installations required to establish adequate primary heat sources.

Dwellings in which no air sealing is needed and in which adequate insulation in the attic, sidewalls, and floor is already present shall require a WA audit in order to ensure that the entire job will still be cost-effective.

The WA software tools may additionally be used to cost-justify refrigerator replacements and to assess the cost-effectiveness of certain health and safety measures, where applicable, to support leveraging and efficient management or program resources.

One or more weatherization personnel members employed by each weatherization service provider shall possess a thorough working knowledge of the WA software.

2120 Photographic Documentation

The job file for every weatherized dwelling shall contain specific photographic documentation of initial, interim, and final weatherization conditions. Circumstances or measures requiring mandatory photographic documentation shall include, but not be limited to:

- A) Conditions resulting in a dwelling being placed on deferral status
- B) Conditions inhibiting installation of priority weatherization measures
- C) Unusual or hazardous conditions encountered during the course of work
- D) Justification for an atypical measure or course of action
- E) Verification of Lead-Safe work practices
- F) Photographs required for State Historic Preservation Office (SHPO) compliance

- G) Existing and replacement appliances or equipment
- H) High-priority measures.

Photographic documentation shall additionally comply with the following minimum specifications:

- A) Images shall be digital
- B) Shall be clear and easy to view
- C) Shall contain captions which identify the job site and the specific events being depicted
- D) Shall be date and time stamped where feasible
- E) Image source files shall be retained electronically and shall be made available upon request
- F) The quantity of photographs taken shall be adequate to document all applicable circumstances and measures
- G) Shall be printed using a quality color printer, grouping not more than six images per 8 ½ in. x 11 in. letter-sized page
- H) Photographs as specified herein shall be maintained in the job file.

2200 Pre-Audit Documentation

2210 Permission to Enter Premises Agreement

Weatherization service providers and dwelling owners shall complete a Permission to Enter Premises form (PEP) prior to the start of the initial energy audit in every weatherized dwelling. The PEP not only provides protection for weatherization service providers, including conveying the legal right to enter a dwelling for purposes of inspection and evaluation, but it also serves as formal notification to the dwelling owner of pertinent NC WAP policies and procedures. By signing the PEP, dwelling owners acknowledge their acceptance of responsibility to cooperate with weatherization providers, should the dwelling be determined eligible for services. Under no circumstances shall weatherization personnel enter a dwelling to perform an initial energy audit, or for any other purpose, prior to a PEP being signed by the dwelling owner and the weatherization service provider.

2220 Occupant Preexisting Health Condition Notification

Weatherization service providers shall specifically request and document preexisting health condition reporting by dwelling occupants in every weatherized dwelling, whether reported during application processing, at the time of initial audit, or throughout the course of weatherization work. Precautions shall be taken where applicable to avoid exacerbating preexisting health conditions. Conditions reported and the associated actions taken, if any, shall be documented in the job file.

2300 Initial Audit Documentation

2310 Residential Energy Audit Tool (REAT)

Applicable sections of the Residential Energy Audit Tool (REAT) shall be completed fully in conjunction with every initial dwelling audit performed as per the NC WAP REAT instructions provided with the tool. Non-applicable sections of the audit tool shall be marked with the designation of N/A. The REAT shall be used to record initial and interim diagnostic test readings and relevant dwelling specific data including, but not limited to, square footage,

existing insulation values, health and safety hazards observed, and the make, model, and type of all existing appliances and heating systems. The REAT shall be provided to weatherization installers and subcontractors where applicable prior to the start of work as a supplement to the dwelling specific scopes of work delivered.

2320 Refrigerator Replacement Evaluation Data

Refrigerator replacement evaluation data shall be maintained in the job file for every dwelling weatherized. Replacement data may be used to perform calculations prepared through use of the NC WAP Refrigerator SIR calculator or the WA software. Replacement evaluation data to be documented shall include, but not be limited to:

- A) Appliance manufacture date, model number, and serial number (where determinable)
- B) kWh/yr of energy consumption, determined by properly metering the appliance or approved database
- C) SIR calculation data used to determine eligibility for replacement
- D) Photographic documentation showing details of existing appliance (where applicable)
- E) Procurement data for replacement appliance (if not using state contract)
- F) Specification data for replacement appliance
- G) Photographic documentation showing details of replacement appliance (where applicable)
- H) Associated expense entry in the AR4CA materials list.

2400 Interim-Audit Documentation

2410 Evaluation, Clean, and Tune

Documentation of a completed Evaluate, Clean, and Tune (ECT) (or the basis for exemption from the requirement) shall be maintained in the job file for every weatherized dwelling. Standard NC WAP ECT reporting documents shall be completed by HVAC technicians performing services and shall record all conditions observed and recommended corrective actions, if any. ECT reports shall contain sufficient details and information to substantiate tasks completed during the ECT, as well as to adequately justify any repair or replacement measures subsequently performed.

2420 Lead-Safe/Renovate Right

In compliance with federal regulations relating to lead paint hazard exposure, weatherization service providers (renovation firms), field personnel (installers and certified renovators), and subcontractors shall jointly be responsible for ensuring that standards governing lead-safe work practices including, but not limited to, the following provisions are at all times adhered to:

- A) Individuals performing activities that disturb painted surfaces on behalf of the firm are either certified renovators or have been trained by a certified renovator
- B) A certified renovator is assigned to each renovation and performs all of the certified renovator responsibilities
- C) Renovations performed by the firm are performed in accordance with the work practice standards of the Lead-Based Paint Renovation, Repair, and Painting Program (RRP)
- D) Pre-renovation education requirements of the Lead-Based Paint RRP Program are met
- E) Mandatory recordkeeping requirements are followed.

Lead-safe documentation including initial, interim, and final-work certifications and acknowledgements shall be maintained in the job file.

2430 State Historic Preservation Office Authorization

The State Historic Preservation Office (SHPO), located within the North Carolina Department of Cultural Resources, is tasked with identifying and safeguarding historic structures and sites. NC WAP has entered into a programmatic agreement with SHPO to review and authorize use of specified weatherization measures proposed for site-built dwellings 45 or more years old which may adversely impact the historic character of such structures.

Weatherization service providers shall be responsible for implementing procedures to ensure compliance with pre-weatherization SHPO project review standards where any of the following measures are proposed for site-built dwellings 45 or more years old:

- A) Measures requiring holes to be drilled in exterior wood weatherboard (siding)
- B) Measures requiring alteration, major repair, or replacement of wood windows
- C) Measures requiring alteration, major repair, or replacement of front wood entry doors
- D) Measures related to installation of solar thermal devices.

Where any of the above measures are proposed, documentation including, but not limited to, the following shall be submitted to SHPO for review and authorization prior to proceeding with work:

- A) Physical dwelling address
- B) Name of dwelling owner
- C) Map denoting the location of the dwelling within the state
- D) Copy of preliminary scope of work (work order) for the dwelling detailing proposed measures
- E) Four or more digital color photographs depicting each dwelling elevation (front, rear, and sides).

SHPO project review documentation shall be submitted by weatherization service providers via electronic mail (only) to: energy.projects@ncdcr.gov. Submission and authorization data and communications shall be maintained in the job file.

2440 Permission to Perform Services and Preliminary Scope of Work

Every dwelling weatherized shall be subject to a Permission to Perform Services from (PPS) signed by the dwelling owner and the weatherization service provider prior to the start of any work (excepting the initial energy audit). Weatherization service providers shall be responsible for obtaining informed written consent from the property owner for all proposed measures and acknowledging a willingness to comply with program guidelines prior to job start via a signed PPS and detailed preliminary scope of work (work order). The following minimum standards shall apply to the PPS:

- A) Weatherization measure proposed for the dwelling shall be described in detail in the attached scope of work, including the method of performance and materials to be used.

- B) Only the dwelling owner can sign authorizing work. Both the dwelling owner and the occupants shall have the right to review and understand the results of the initial audit or other inspections and the details regarding each proposed measure prior to the start of work.
- C) Dwelling owners shall have the right to refuse performance of any measure; however, refusal to authorize performance of particular measures may result in non-performance of all or other proposed measures.
- D) Weatherization service providers shall provide information as needed to ensure that owners (and to the extent possible, occupants) possess a thorough understanding of the services that will *and* will not be provided at the dwelling.
- E) Signature by each dwelling owner or co-owner shall be required to authorize work.

2450 Work Orders, Change Orders, and Scope of Work

Standard NC WAP work order and change order documents shall constitute the formal scope of work for weatherization jobs. The terms of standard NC WAP weatherization subcontractor agreements, as well as compliance with NC WAP standards, mandate that a scope of work be issued to weatherization personnel and subcontractors containing detailed specifications for all measures performed on weatherized dwellings. Work orders shall be generated by initial auditors or weatherization management as appropriate, based on dwelling data collected during the initial audit and recorded in the REAT. Work orders and, as needed, change orders shall contain reasonable estimates of labor and material expenses associated with each specified measure and shall be delivered to field personnel and subcontractors prior to installation of the measures specified.

Weatherization personnel and subcontractors shall perform measures as specified in work order and change order documents only. Deviation from the scope of work initially supplied by the weatherization service provider in the form of a compliant work order shall require written documentation and authorization for the revision in scope issued in the form of change order. The scope of work specified in the work orders/change orders for the job shall form the basis by which subcontractors shall be compensated and by which invoices and expenditures submitted to NC WAP shall be evaluated prior to payment.

2460 Prohibition on Smoking and Tobacco Use

NC WAP funded jobsites and vehicles shall at all times be smoke and tobacco-free environments. Cigarette smoking or the use of other tobacco products including, but not limited to, pipes, cigars, snuff, or chewing tobacco by weatherization personnel or subcontractors shall not be allowed on any portion of a weatherization jobsite. A weatherization jobsite shall include the dwelling and the surrounding property on which the weatherized dwelling is located. Use of tobacco products of any type shall also be prohibited inside any vehicle owned, leased, or rented by a weatherization service provider. Failure to adhere to limitations on the use of tobacco products on weatherization jobsites or in WAP funded vehicles may result in administrative action.

2470 Warranty Documentation and Operating Manuals

Manufacturer warranty documentation and operation manuals for all newly installed appliances and equipment shall be obtained from the subcontractor, distributor, or manufacturer and provided to the dwelling owner prior to completion of the final inspection. Effort shall be made to provide warranty documentation and operation manuals in Spanish or other languages where needed to aid non-English speaking clients.

Final inspectors shall be responsible for ensuring that essential information regarding the proper operation and maintenance of appliances and equipment, as well as instructions for initiating warranty related repairs, is clearly explained to dwelling owners prior to completion of the final inspection and formal acceptance of services.

2.0702.1a	Warranty	A minimum 1-year warranty for materials, workmanship, and serviceability will be provided to occupants upon completion of work	Provide recourse to occupants for failures in materials, workmanship, and serviceability
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3000 Priority List of Measures

The NC WAP Priority List of Measures for Site-Built Dwellings, approved by DOE, serves as the basis upon which the majority of weatherization measures shall be performed in North Carolina dwellings. The priority list was developed based on data collected by conducting numerous computerized audits performed on typical low-income housing stock throughout the state using the WA software. Audit data collected identified the following “frequently recommended” measures as being the most cost-effective to perform based on the measures consistently delivering an SIR of 1.0 or greater. The coastal counties are as follows: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hyde, New Hanover, Onslow, Pamlico, Pender, Pasquotank, Perquimans, Tyrrell, and Washington.

A dwelling-specific computerized audit shall be mandated per applicable guidelines herein, particularly where *non-priority list measures* are proposed for a particular dwelling. Energy-related health and safety measures shall be considered on a dwelling-by-dwelling basis and are not subject to cost-effectiveness requirements.

3100 Priority List of Measures for Site-Built Dwellings

1. Energy Related Health and Safety

(Chapters 5000—Energy Related Health and Safety)

2. Duct Sealing and Associated Insulating

(Chapter 8000—Duct Sealing & Insulating)

3. Infiltration Reduction

(Chapter 9000—Air Sealing)

4. Lighting Upgrades (CFLs & LEDs)

(Chapter 11000—Baseload Reduction and General Heat Waste)

5. Refrigerator Evaluation

(Chapter 11000—Baseload Reduction and General Heat Waste)

6. Attic Insulation

(Chapter 10000—Insulation)

7. Dense Pack Sidewalls

(Chapter 10000—Insulation)

8. Floor Insulation – Excludes Coastal Dwellings with Heat Pumps

(Chapter 10000—Insulation)

4000 Client Education & Notification Requirements

Weatherization services provide a greater and more lasting benefit where clients are partners in the process, working alongside weatherization service providers. As in any partnership, each partner in the weatherization process has certain responsibilities and expectations. NC WAP and its network of providers are charged with quality installation of appropriate energy-saving measures intended to reduce fuel and utility expenses in weatherized dwellings and, where possible, to increase comfort for client households. Weatherization clients are responsible for cooperating with reasonable requests made by weatherization service providers before, during, and after weatherization process. Where the weatherization partnership is well balanced, the result can be greater energy savings, lower fuel and utility bills, and increased client comfort.

Delivery of quality client education plays a large role in a balanced weatherization partnership by enabling clients to understand and participate in improving the efficiency of their dwelling. Weatherization client education includes discussion, instruction, brochures, and pamphlets that explain the weatherization process, measures installed and how to use them, low-cost/no-cost ways to save energy, and how to avoid potential dwelling-related safety hazards.

Weatherization service providers shall ensure that weatherization personnel responsible for providing weatherization client education are proficient in the knowledge required to effectively deliver quality client education including, at minimum, possessing a strong working knowledge of:

- A) Basic steps in the weatherization process, including auditing, testing, installation, inspection, and monitoring
- B) Actions that can be taken to reduce energy use in the dwelling
- C) Actions that can be taken to maintain a safe and healthful indoor environment
- D) The purpose and operation of basic equipment involved in the weatherization process, including blower door, pressure pan, combustion analyzer, gas leak detector, insulation blowing machine, and generator
- E) Techniques to demonstrate estimated economic impacts of suggested actions to bolster occupant commitment to changes in household behaviors.

Client education shall be provided throughout the weatherization process and shall be repeated as needed to ensure clients are comfortable with the information provided.

5.3003.7a	Basic operation	Basic operation of the equipment will be explained to the occupant (e.g., design conditions, efficiency measures, differences from previous system or situation)	Ensure occupant has a reasonable expectation of the equipment's capability
5.3003.7b	System controls (e.g., thermostat, humidistat)	Proper operation and programming of system controls to achieve temperature and humidity control will be explained to the occupant	Ensure occupant can operate system controls
5.3003.7c	System disconnects	Indoor and outdoor electrical disconnects and fuel shut-offs will be demonstrated to occupant	Ensure occupant can shut off equipment in emergencies
5.3003.7d	Combustion air inlets	Location of combustion air inlets will be identified for occupant in accordance with NFPA 31, 54, and 58 Importance of not blocking inlets will be explained to occupant	Ensure occupant does not block combustion air inlets
5.3003.7e	Blocking air flow	Importance of cleaning dust and debris from return grilles will be explained to occupant Proper placement of interior furnishings with respect to registers will be explained to occupant Negative consequences of closing registers will be explained to occupant Importance of leaving interior doors open as much as possible will be explained to occupant	Ensure occupant does not prevent equipment from operating as designed

5.3003.7f	Routine maintenance	Proper filter selection and how to change the filter will be explained to occupant Importance of keeping outside unit clear of debris, vegetation, decks, and other blockage will be explained to occupant Importance and timing of routine professional maintenance will be explained to occupant	Ensure equipment operates as designed
5.3003.7g	Calling heating, ventilation, and air conditioning (HVAC) contractor	Situations when the occupant should contact the HVAC contractor will be explained, including: <ul style="list-style-type: none"> Fuel odors Water draining from secondary drainline Emergency heat indicator always on for a heat pump system System blowing cold air during heating season and vice versa Icing of the evaporator coil during cooling mode Outside unit never defrosts Unusual noises Unusual odors 	Notify occupant to contact installer when system is not operating as designed
5.3003.7h	Carbon monoxide (CO)	A carbon monoxide (CO) alarm will be installed	Occupant will be made aware of operation of CO alarm
5.3003.7i	Warranty and service	Occupant will be provided with relevant manuals and warranties The labor warranty will be explained and the occupant will be given a phone number to call for warranty service	Provide manuals and warranties for future servicing

4100 Energy Education

Changing household behaviors is a key factor in improving the energy consumption in a dwelling. When household members become aware that choices related to thermostat settings, hot water usage, and switching off unused electrical devices can reduce energy bills, occupants are more likely to adopt energy-saving behaviors.

Client energy education shall be provided to client households in every weatherized dwelling and shall include relevant, dwelling-specific information on energy efficiency improvements including, but not limited to:

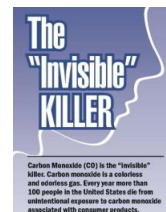
- A) Heating and cooling system efficiency
- B) Infiltration and air sealing
- C) Thermal comfort improvements
- D) Indoor air quality (IAQ) improvements
- E) Baseload energy reduction
- F) General heat loss improvements.

4200 Health and Safety Education

In addition to energy education, client households shall also be provided with client health and safety education to advise clients of potential dwelling-related health and safety hazards which may be present, created, or exacerbated by weatherization work.

Mandatory delivery of specific client education and the related reference publication for the following topics shall be provided to *dwelling owners and occupants* in every dwelling prior to the start of weatherization work. Weatherization educators shall underscore the importance of the information provided for each topic and shall fully answer questions and address concerns raised by clients, if any.

Carbon Monoxide (CO)—is an odorless, colorless, tasteless, poisonous gas produced by incomplete combustion. CO poisoning poses immediate harm to humans and pets and can be fatal. Any fossil fuel-burning activity including cooking, automobile, or heating system exhaust is a potential source for CO exposure. Every client household shall be educated on the potential health hazards related to CO poisoning and provided with a copy of *The Invisible KILLER*.



Lead—exposure to lead dust, commonly found in dwellings containing lead-based paint, can adversely affect child brain and nervous system development, causing learning disabilities and behavioral problems. Lead dust exposure is also harmful to adults. Federal law mandate that individuals receive notification of potential lead hazards prior to the start of interior or exterior renovation projects in housing built in or before 1978. Every client household shall be educated on the potential health hazards related to lead dust exposure and provided with a copy of *The Lead-Safe Certified Guide to Renovate Right*.



Mold and Moisture—because tightening a dwelling through air sealing may cause an increase in relative humidity levels indoors, dwelling occupants shall be informed about how to identify moisture related problems and possible solutions. Every client household shall be educated on the potential health hazards related to mold and mildew exposure and be provided with a copy of *A Brief Guide to Mold, Moisture, and Your Home*.



Radon—is a naturally occurring, colorless, odorless, tasteless, cancer-causing, radioactive gas found throughout the United States. Tightening a dwelling through air sealing may cause an increase in indoor radon levels. Every client household shall be educated on the potential health hazards of exposure to radon gas and provided with a copy of *A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon*.



Spray Polyurethane Foam (SPF)—is a widely used and highly effective insulator and sealant. However, exposure to its key ingredient, isocyanates, and other SPF chemicals in vapors, aerosols, and dust during *and after installation* can exacerbate health conditions including asthma, other respiratory conditions, and severe skin and eye irritation. Every client household shall be educated on the potential health hazards related to SPF products and provided with a copy of *Weatherizing your home with SPF*.



A written acknowledgement of receipt for each topic, as well as any related communication on these and other topics shall be maintained in the job file.

Additional client health and safety education topics to be reviewed with client households as needed based on actual conditions present in the dwelling shall include, but shall not be limited to:

- A) Maintaining weatherization jobsite safety
- B) Hazardous materials exposure and proper handling (existing or used during work)
- C) Electrical hazards and fire safety
- D) Structural integrity, fall hazards, or other building durability issues

- E) Biological and sanitation hazards, including insect or rodent infestations, animal dander or feces, raw sewage contamination, or hazards related to the presence of excess debris

4300 Weatherization Process Education

Ensuring a smooth and beneficial weatherization experience also requires that client households be informed and updated regularly about what is expected from throughout the weatherization process.

Aspects of the weatherization process that shall be discussed with client households at various stages throughout the weatherization process shall include, but not be limited to:

- A) Schedule of milestone events in the weatherization and HARRP processes
- B) Who will communicate with the client and when
- C) Events that shall take place before weatherization work can begin
- D) What to expect during the energy audit
- E) Client responsibilities to prepare for weatherization
- F) Who will perform weatherization work
- G) Daily work schedule
- H) Weatherization measures and appliance that will be installed as part of weatherization
- I) Repairs or improvements that will *not* be provided in conjunction with weatherization
- J) Personal property that will be altered or removed during weatherization
- K) When the work will be complete
- L) Final inspection and quality assurance monitoring processes
- M) How the dwelling may perform differently as a result of weatherization
- N) Proper operation and maintenance of new or existing equipment and systems

5000 Energy-Related Health and Safety

While the primary purpose of NC WAP is to reduce energy use for elderly, disabled, and low-income residents, ensuring the health and safety of clients and personnel must always be the most paramount factor for all weatherization service providers and related weatherization professionals.

Allowable energy-related health and safety measures shall be defined as only those specified measures deemed necessary by NC WAP to maintain the physical wellbeing of the dwelling, the dwelling occupants, and weatherization personnel. Energy-related health and safety measures shall be allowable only where energy efficiency measures are also installed.

Effective management and implementation of energy-related health and safety measures require weatherization service providers to clearly understand:

- A) Jobsite conditions that are necessary to effectively perform weatherization work
- B) Changes in jobsite conditions that are necessary as a result of weatherization work
- C) Expenses that are allowable or required to ensure jobsite conditions are as safe as possible for weatherization personnel and dwelling occupants before, during, and after weatherization.

The extent to which allowable energy-related health and safety concerns can reasonably be addressed using available health and safety resources is inherently limited; therefore, dwellings must be evaluated on a case-by-case basis. Placing dwellings in deferral status shall be required wherever energy-related health and safety concerns cannot be adequately addressed.

The decision to defer work in a dwelling is difficult, but cannot be avoided in some instances. This does not mean that assistance will never be available, but rather that work must be postponed until health and safety problems can be resolved and/or alternative sources of assistance can be located.

5100 Health & Safety Education and Hazard Notification

Weatherization service providers shall be responsible for providing energy-related health and safety education to client households living in every dwelling weatherized in compliance with applicable standards herein for mandatory client education. This responsibility shall specifically apply to educating clients about the potential risks and necessary safety precautions associated with each section of this chapter.

In every instance weatherization service providers shall be responsible for notifying property owners and dwelling occupants, both verbally and in writing, of pertinent facts and necessary safety precautions relating to any conditions observed on a jobsite that could result in harm or loss to either life or property. Examples of such conditions may include, but shall not be limited to, code compliance issues, existing or potential health and safety hazards, or any atypical condition encountered on the jobsite.

Notification requirements shall apply to all activities undertaken in conjunction with the provision of weatherization program services and to *all* sections of the Installation Standards. Notification requirements shall include observation of hazard conditions that may fall outside the scope of weatherization activities.

5200 Energy-Related Health and Safety Expenditures

Allowable energy-related health and safety measures, where provided in conjunction with required energy efficiency measures and in compliance with applicable standards and limitations shall include, but not be limited to:

- A) Repairing or replacing unsafe, nonfunctioning, or inadequate HVAC systems or components
- B) Correcting IAQ issues
- C) Preventing excess moisture intrusion
- D) Repairing minor plumbing problems
- E) Repairing or replacing leaking or unsafe water heaters
- F) Repairing minor electrical problems
- G) Installing carbon monoxide and smoke alarms
- H) Repairing unsafe fuel-fired cook stoves
- I) Performing lead-safe work practices
- J) Properly addressing asbestos
- K) Purchasing personal protective equipment (PPE)
- L) Procuring pest or termite control services
- M) Testing for radon in moderate to high potential risk areas
- N) Removing excess debris from dwellings in limited instances.

Prohibited activities shall be defined as activities which are not permitted by NC WAP under any circumstances and as those activities conducted in a manner which does not comply with applicable NC WAP technical standards or administrative guidelines.

Prohibited activities shall include, but not be limited to:

- A) Treating to kill viruses or bacteria
- B) Installing or repairing portable or unvented space heaters
- C) Installing or repairing attic, ceiling, or portable fans
- D) Installing or repairing heat recovery ventilators or energy recovery ventilators
- E) Installing or repairing humidifiers or dehumidifiers
- F) Installing or repairing wheelchair ramps or bathroom grab bars
- G) Installing or repairing septic tanks, covers, or lines
- H) Installing toilets and tubs
- I) Auguring clogged drains
- J) Installing or repairing windows and doors*
- K) Installing or repairing refrigerators*
- L) Installing cook stoves
- M) Installing any appliance not expressly specified as an allowable energy-related health and safety measure including, but not limited to, clothes washers or dryers, dishwashers, microwaves, and stand-alone freezers.

This list of prohibited or disallowed activities shall **not** be considered exhaustive. Where clarification of prohibited or disallowed activities is required, weatherization service providers shall be responsible for contacting NC WAP prior to any expenditure of health and safety resources. Misappropriation of energy-related health and safety resources to perform prohibited activities shall result in the expenditure being disallowed.

*Under no circumstances shall repair or replacement of refrigerators, windows, or doors be allowed as an energy-related health and safety measure.

2.0111.2e	Pest and termite work	Pest and termite treatment will be completed before crawl space upgrade and inspected in accordance with the 2012 IRC	Prepare site for upgrade
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5300 Occupant Pre-existing Health Conditions

Special precautions shall be taken where any occupant of a weatherization-eligible dwelling suffers from respiratory ailments, allergies, is pregnant, or has a similar health condition that puts the occupant at greater potential risk for medical complications as a result of any aspect of weatherization work. It shall be the responsibility of the weatherization service provider to document any such condition reported by any member of the client household, whether during the application process, at the time of initial audit, or as work progresses and to immediately inform weatherization workers of any precautions that must be taken to avoid exacerbating the reported health condition.

In particular circumstances, temporary relocation of at-risk household members may be the most appropriate course of action to avoid potential exposure to hazardous conditions. Weatherization service providers shall communicate with client households in advance of scheduling weatherization services to identify viable personal alternatives that may be arranged by the dwelling occupants for temporary relocation; for example, temporary relocation to the home of a friend or relative. In extreme circumstances, it may necessary for the weatherization service provider to provide for temporary relocation of the at-risk household member. Authorization for the use of health and safety resources to provide for temporary relocation shall be considered in extreme circumstances and on a case-by-case basis, and may be expended only with the prior written consent of NC WAP.

Where weatherization personnel encounter clients suffering from bacterial infections or viruses known to be contagious, weatherization service provider management shall be contacted and, where instructed, work may be deferred to allow for the individual suffering from the illness to recover and the contagious period for the specific illness to pass.

Where a weatherization service provider is for any reason unable to implement necessary precautionary measures or to take actions required to avoid the potential for exacerbation of pre-existing occupant health concerns (including refusal by the dwelling occupants to reasonably comply with requests for temporary relocation), the dwelling shall be placed in deferral status and no weatherization work shall be performed until adequate safety precautions can be implemented.

Documentation and required notifications related to any such instance shall be maintained in the job file.

5400 Weatherization & Health and Safety Hazards

Weatherization program services shall at all times be provided in a manner that minimizes risk to client households. Any conditions which exist that may endanger the health or safety of the dwelling occupants and which cannot be resolved within the scope of allowable health and safety measures shall result in the dwelling being placed in deferral status until the conditions can be corrected.

Precautions to ensure occupant and worker health and safety shall at all times include the responsibility of weatherization service providers, personnel, and contractors to recognize potential hazards related directly to

weatherization work and to take action to limit exposure to, or exacerbation of, the potentially hazardous condition.

5410 Blower Door Operating Hazards

As a standard practice, blower door diagnostic testing shall be performed only after a dwelling has been thoroughly inspected, potential hazards identified and, where required, necessary precautions taken to remove, encapsulate, or otherwise mitigate the hazard to a level at which blower door diagnostics can safely proceed. Where risks related to hazardous material fibers or vapors being raised and circulated through the air during blower door operation exist, performing blower door diagnostics using the pressurization, rather than the depressurization method, may be appropriate.

5420 Spray Polyurethane Foam

Spray polyurethane foam (SPF) is a widely used and highly effective insulator and sealant. However, exposure to its key ingredient, isocyanates, and other SPF chemicals in vapors, aerosols, and dust during and after installation can exacerbate:

- A) Asthma, a potentially life-threatening disease
- B) Sensitization, which can lead to asthma attacks if susceptible
- C) Other respiratory and breathing problems
- D) Skin and eye irritation.

The minimum safety precautions required where SPF is used shall include, but not be limited to:

- A) Ensuring health and safety training is completed and safe work practices are followed to prevent eye, skin, and inhalation exposures during and after SPF installation
- B) Exercising caution when determining safe re-entry times for unprotected dwelling occupants and workers based on the manufacturer's recommendations
- C) Regular review of label and product information for ingredients, hazards, directions, safe work practices, and precautions.

Weatherization service providers shall minimize or restrict the use of materials that may be hazardous to the client to the extent feasible; however, where the weatherization service provider must allow the use of hazardous chemicals or materials, the contents, precautions, and potential consequences of exposure to the hazard shall be disclosed in writing to both the dwelling owner and the dwelling occupants prior to use and the parties must sign to acknowledge understanding of the information provided and to grant consent to proceed with work prior to use of the chemical or material. Documentation of the notification and consent shall be maintained in the job file. Installation of hazardous materials shall always be performed in ventilated areas to the full extent practical. SPF shall never be used where the foam will be visible by a casual inspection of the main living areas (e.g. interior ceiling wall junctions).

2.0100.1c	Respiratory protection	<p>If the risk of airborne contaminants cannot be prevented, proper respiratory protection will be provided and worn (e.g., N-95 or equivalent face mask)</p> <p>When applying low pressure 2-component spray polyurethane foam, air purifying masks with an organic vapor cartridge and P-100 particulate filter will be used</p> <p>When applying high-pressure SPF insulation, supplied air respirators (SARs) will be used</p> <p>Consult MSDSs for respiratory protection requirements</p>	Minimize exposure to airborne contaminants (e.g., insulation materials, mold spores, feces, bacteria, chemicals)
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5440 Formaldehyde and Volatile Organic Compounds

Substances containing formaldehyde, volatile organic compounds (VOCs), and similar air polluting agents which pose a potential risk to weatherization workers and dwelling occupants shall be identified and, where feasible, removed from the dwelling prior to weatherization work commencing. Where it is not feasible to remove such pollutants, care shall be taken not to disturb the substances and to limit exposure to the extent possible.

5500 Jobsite Management Hazards

5510 Excess Debris and Personal Property

Excess debris and other items located in and around dwelling units may not only pose potential health and safety risks to weatherization workers and dwelling occupants, but likely also inhibits proper execution of weatherization measures. Weatherization service providers shall be responsible for identifying and mitigating any such hazardous conditions prior to proceeding with weatherization services.

Where feasible, weatherization service providers may request that clients be responsible for the removal of excess debris and personal property from the dwelling. Where the property owner and/or the dwelling occupants are incapable of removing the items, it shall be allowable for weatherization service providers to provide for a reasonable amount of removal. All personal property surrendered or removed from a dwelling by weatherization personnel or contractors shall be documented in the job file, including written authorization from the dwelling owner as well as photo documentation of items removed.

Emphasis shall be placed on removing excess debris or extraneous items from attics, crawl spaces, the dwelling perimeter, and exterior doorways.

Large amounts of excess clutter contained in dwellings includes trash, clothing, collectables, toys, boxes, building materials, furniture, machinery, tires, or similar items which inhibit the ability of weatherization workers to fully access all areas of the dwelling to perform inspections and repairs or to install measures. The excess clutter poses greater potential hazards to weatherization workers and dwelling occupants, in addition to inhibiting the proper execution of weatherization measures. Where excessively cluttered conditions exist, effort shall be required either by the client or the weatherization service provider, as appropriate, to substantially de-clutter the dwelling prior to weatherization work commencing.

2.0111.3a	Debris removal	Under-floor grade will be removed of all vegetation and organic material, unnecessary material, and debris greater than 1" will be removed from the crawl space (e.g., rake the crawl space)	Minimize punctures in ground liner Minimize habitat for pests (Integrated Pest Management—IPM) and contaminant sources
2.0111.3b	Debris disposal	Debris will be properly disposed of according to type and jurisdiction	Protect environment from damage

5520 Biological Hazards and Poor Sanitation

Unsanitary dwelling conditions contribute to a host of potential biological hazards that can cause illnesses. Dwelling occupants are often unaware of household conditions that may promote biological hazards.

Weatherization service providers shall educate clients, where applicable, on locations within a dwelling (for example kitchens, bathrooms, and doorknobs) where biological hazards may be present, as well as regular housekeeping, food storage, and hand washing techniques essential to maintaining a safe and sanitary home.

Weatherization personnel shall be trained to identify and properly manage situations where potential biological hazards are encountered. For example, proper management of raw sewage discovered in a crawl space might consist of steps such as:

- A) Ceasing all crawl space work to avoid contact with the potential hazard
- B) Notifying weatherization management and the dwelling occupants that a potentially hazardous condition has been identified and should be avoided until corrected
- C) Documenting the circumstances surrounding identification of the hazard in the job file
- D) Procuring services from a licensed plumber to assess and then correct the problem where only a minor issue exists
- E) Taking steps to avoid any future contact with the hazard, including allowing the area to dry completely prior to resuming work and ensuring personnel wear PPE while working in the crawl space.

Measures to remediate conditions that may lead to or promote biological hazards shall be considered on a case-by-case basis. Measures intended specifically to eliminate the presence of bacteria and or viruses shall not be allowed. Where extreme conditions exist that are outside the scope of allowable health and safety measures, the dwelling shall be placed in deferral status until the conditions corrected.

5530 Insects and Rodents

Where mild or moderate insect or rodent infestation exists, the use of respirators and protective clothing shall be of even greater importance to avoid inhalation and skin contact with droppings. Protective goggles shall additionally be advisable to prevent contact through the eyes. Where severe insect or rodent infestations exist in a dwelling which may hinder safe weatherization work by endangering clients or workers, extermination or removal by a properly trained and/or licensed extermination professional shall be allowable. Extermination, where performed, shall be completed in advance of weatherization work commencing. In the case of insecticide applications, sufficient time shall be allowed for complete ventilation of treated areas to avoid unnecessary inhalation of the insecticides.

Written authorization by the dwelling owner and notification acknowledgment by the dwelling occupants shall be required prior to weatherization service providers procuring any insect and rodent removal treatment or services,

and documentation of all services and related authorizations and acknowledgements shall be maintained in the job file. Where infestations are particularly serious, notifying the local health department may be advisable.

Hazards related to insect or rodent infestations may include, but shall not be limited to, the following:

- A) Bees and Wasps
Flying insect stings can cause severe allergic reactions, and in rare instances may result in death
- B) Roaches, Fleas, Rats, and Mice
Extreme crawling insect infestations may be hazardous to the health of dwelling occupants and weatherization workers since contact with droppings or feces may cause infectious diseases. Disinfectant wipes may be needed to cleanse skin and contaminated areas, as soap and water alone may not kill harmful feces-related bacteria. Medical attention shall be sought for a rat or mouse bite, or for flea or roach bites that cause extreme irritation.
- C) Bats
Work performed where bat feces or guano is present may present even greater potential hazards.
- D) Snakes
Snakebites shall require that the individual bitten be transported to a medical facility immediately, particularly if the person was bitten by a snake confirmed as being venomous. First aid may be required prior to or during transport.

5540 Dwelling Accessibility Limits

As a practical consideration, as well as a health and safety matter for weatherization personnel, weatherization measures shall not be required in portions of a dwelling crawl space where clearances of 24 in. or less as measured from the bottom of the floor joists to the ground below exist.

Where crawl space clearances restrict access to portions of a crawl space, priority weatherization measures including, but not limited to, vapor barrier installation, air sealing, and installing insulation shall be required in the accessible portions of the crawl space.

Though measures shall not be required in crawl space areas with clearances of 24 in. or less, reasonable efforts shall be made on the part of weatherization service providers and weatherization personnel to complete measures to the fullest extent practicable in an effort to provide the greatest potential benefit to clients.

2.0100.1a	Prevention through design	Design will be incorporated to eliminate or minimize hazards (e.g., material selection, access to equipment for installation and maintenance, placement of equipment, ductwork and condensate lines)	Prevent worker injuries Reduce risk exposure to toxic substances and physical hazards
2.0100.1b	Hand protection	Durable and wrist-protecting gloves will be worn that can withstand work activity	Minimize skin contact with contaminants Protect hands from sharp objects

2.0100.1i	Chemical safety	<p>Hazardous materials will be handled in accordance with manufacturer specifications or MSDS standards to eliminate hazards associated with volatile organic compounds (VOCs), sealants, insulation, contaminated drywall, dust, foams, asbestos, lead, mercury, and fibers</p> <p>Appropriate personal protective equipment (PPE) will be provided</p> <p>Workers will be trained on how to use PPE</p> <p>Workers will be expected to always use appropriate PPE during work</p>	Prevent worker exposure to toxic substances
2.0100.1m	Heat and thermal stress	<p>Appropriate ventilation, hydration, rest breaks, and cooling equipment will be provided</p> <p>911 will be dialed when necessary</p>	Prevent heat stroke, heat stress, and cold stress related injuries
2.0110.1a	Material selection	Materials that do not create long-term health risks for occupants and workers will be used	Improve indoor air quality in the living space
2.0110.1b	Material labels	Manufacturer specifications will be followed	<p>Reduce risk of exposure to harmful substances</p> <p>Follow safety procedures</p>
2.0110.1c	Material Safety Data Sheets (MSDSs)	MSDSs will be provided onsite and available during all work	<p>Assess exposure risk</p> <p>Prepare a response in case of emergency</p>

5550 Jobsite Injury Prevention

Weatherization service providers shall take all reasonable precautions against performing work on dwellings where that work will subject weatherization personnel or dwelling occupants to health and safety risks, including risk of falls. *Minor* repair shall be allowable to secure steps and handrails where such actions are necessary to effectively weatherize the dwelling. Measures deemed unnecessary or excessive shall be prohibited.

2.0100.1f	Protective clothing	<p>MSDSs and OSHA regulations will be consulted for protective clothing and equipment</p> <p>Eye protection will always be worn (e.g., safety glasses, goggles if not using full-face respirator)</p>	<p>Protect worker from skin contact with contaminants</p> <p>Minimize spread of contaminants</p>
2.0100.1g	Confined space safety	<p>Access and egress points will be located before beginning work</p> <p>Inspection will be conducted for frayed electrical wires</p> <p>Adequate ventilation will be provided</p> <p>Use of toxic material will be reduced</p>	<p>Prevent build-up of toxic or flammable contaminants</p> <p>Provide adequate access and egress points</p> <p>Prevent electrical shock</p>
2.0100.1h	Power tool safety	<p>Power tools will be inspected and used in accordance with manufacturer specifications to eliminate hazards associated with missing ground prongs, ungrounded circuits, misuse of power tools, noise, and improper or defective cords or extension cords</p> <p>All devices used will be verified as GFCI protected or double insulated</p> <p>Exhaust gases from compressors and generators will be prevented from entering interior space</p>	Prevent power tool injuries
2.0100.1j	Ergonomic safety	<p>Appropriate PPE will be used (e.g., knee pads, bump caps, additional padding)</p> <p>Proper equipment will be used for work</p> <p>Proper lifting techniques will be used</p>	Prevent injuries from awkward postures, repetitive motions, and improper lifting
2.0100.1k	Hand tool safety	Hand tools will be used for intended purpose	Prevent hand tool injuries
2.0100.1l	Slips, trips, and falls	<p>Caution will be used around power cords, hoses, tarps, and plastic sheeting</p> <p>Precautions will be taken when ladders are used, when working at heights, or when balancing on joists</p> <p>Walk boards will be used when practical</p>	Prevent injuries due to slips, trips, and falls

5560 Jobsite Awareness and Communication

Weatherization service providers shall be responsible for ensuring that all weatherization personnel and subcontractors are knowledgeable and capable of understanding and communicating potential safety concerns to dwelling occupants on an ongoing basis as the weatherization job progresses. Clients shall be educated prior to the start of work on the necessity to secure the work area to avoid injuries to adults, children, and pets, and weatherization personnel and subcontractors shall be responsible for continual reinforcement of this education.

Clients shall be responsible for ensuring weatherization tools, equipment, or materials on the jobsite are not disturbed, and likewise weatherization workers shall be responsible at all times for securing such items on the jobsite and leaving a reasonable pathway for dwelling occupants to move about wherever possible, which allows them to avoid contact with potential hazards.

Where weatherization personnel encounter circumstances where they cannot reasonably secure the work area or where there is a failure by the client to avoid work disturbances by people and/or pets, weatherization personnel and contractors shall notify weatherization service provider management and cease work where necessary until such time as a safe work area can be established on the jobsite.

5600 Dwelling-Specific Health and Safety Hazards

5610 Emergency Situations

During the course of an audit or weatherization work, situations may be encountered which warrant immediate action; for example, the presence of elevated CO levels or a fire. Weatherization service providers shall be responsible for determining the safest and most prudent course of action should an emergency situation be encountered, including determining whether or not the client may safely remain in the dwelling. Utility providers and local jurisdictions may have specified emergency response protocols which shall be respected.

Documentation of actions taken in the event of an emergency shall be maintained in the job file.

2.0105.1a	Worker safety	All worker safety specifications in Global Worker Safety section will be followed	Prevent injury Minimize exposure to health and safety hazards
2.0105.1b	Carbon monoxide (CO)	Ambient CO will be monitored during combustion testing and testing will be discontinued if ambient CO level inside the home or work space exceeds 35 parts per million (ppm)	Protect worker and occupant health
2.0105.1c	Raw fuel	Raw fuel leaks will be monitored for before entering building spaces If leaks are found, testing will be discontinued and condition reported to occupant immediately	Protect worker and occupant health
2.0111.2a	Fuel leaks	Fuel leaks will be repaired and inspected in accordance with the 2012 IRC	Ensure site is safe and ready for upgrade
2.0201.1a	Assessment	Emergency problems (e.g., gas leak, ambient CO levels that exceed 35 ppm) will be communicated clearly and immediately to the customer and appropriate solutions will be suggested Determine if combustion and dilution air is adequate for proper combustion and venting of all equipment within the CAZ Examine appliance for signs of damage, misuse, improper repairs, and lack of maintenance	Ensure system does not have fatal problems Ensure combustion appliance has adequate combustion and dilution air

2.0201.1b	Fuel leak detection	<p>Inspect and test for gas or oil leakage at connections of natural gas, propane piping, or oil systems</p> <p>If leaks are found, immediate action will be taken to notify occupant to help ensure leaks are repaired</p> <p>The report will specify repair for leaks and replacement for hazardous or damaged gas or oil connectors and pipes</p>	<p>Detect fuel gas leaks</p> <p>Determine and report need for repair</p>
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5620 Carbon Monoxide Poisoning

Carbon monoxide (CO) is an odorless, colorless, tasteless, and poisonous gas produced by incomplete combustion. Even limited exposure to high levels of CO or CO poisoning can result in serious illness and/or death. Due to the extremely hazardous nature of CO poisoning, weatherization service providers shall be responsible for testing, identifying, documenting, and correcting conditions that contribute to CO levels inside dwelling units that are in excess of applicable standards.

All fuel-fired appliances including, but not limited to, furnaces, boilers, domestic water heaters, cooking appliances, and clothes dryers shall be safety tested using allowable combustion testing methodology and diagnostic equipment. Direct-vent and sealed combustion appliances need not be draft tested, but levels shall be tested as a matter of precaution. All combustion appliances present in the dwelling, regardless of age or date of installation, shall be tested at specified intervals per applicable standards for combustion testing referenced herein.

The results of all CO testing performed, as well as the details of any actions taken to correct elevated CO levels, shall be documented in the job file.

2.0100.1e	Carbon monoxide (CO)	<p>All homes will have a carbon monoxide alarm</p> <p>Ambient CO will be monitored during combustion testing and testing will be discontinued if ambient CO level inside the home or work space exceeds 35 parts per million (ppm)</p>	Protect worker and occupant health
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5621 Carbon Monoxide Alarms

Not less than one properly functioning carbon monoxide alarm shall be present on each level of a weatherized dwelling. Existing carbon monoxide alarms that are functioning properly at the time of the initial audit shall not be replaced. Where installed, carbon monoxide alarms shall be equipped with:

- A) A digital liquid crystal display (LCD)
- B) An alarm capable of producing 85 decibels at a distance of 10 ft.
- C) An electrochemical sensor with a warranty of not less than 5 years.

Excepting instances where the Installation Standards conflict with manufacturer specifications or local codes, carbon monoxide alarms shall be installed such that the devices are:

- A) Located not less than 15 ft. away from any fuel-fired appliance
- B) Located as close to each main sleeping area (multiple alarms may be required for dwellings with multiple sleeping areas) as possible
- C) Not located in proximity to high moisture areas such as bathrooms
- D) Located at the optimal height as specified by the device manufacturer.

2.0201.2c	CO detection and warning equipment	CO detection or warning equipment will be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in accordance with ASHRAE 62.2 and authority having local jurisdiction	Alert occupant to CO exposure
2.0301.2b	CO detection and warning equipment (battery operated)	Battery operated CO detection or warning equipment will be installed in accordance with ASHRAE 62.2 and manufacturer specifications as required by the authority having jurisdiction	Ensure proper installation

As of the effective date of the Installation Standards, NC WAP is unaware of any combination unit that meets the minimum applicable standards for both carbon monoxide and smoke alarms. Combination carbon monoxide/smoke alarms that meet the minimum standards for both devices listed (should such devices become available in the future) shall be allowable.

Weatherization service providers shall ensure that clients are well educated regarding the purpose and operation of carbon monoxide alarms, the actionable carbon monoxide levels for their device, and the appropriate safety precautions to take, should an alarm occur.

5630 Fire Hazards

Weatherized dwellings shall be inspected for conditions which pose potential fire hazards. Reasonable efforts shall be made to eliminate existing or potential fire hazards where encountered. Eliminating many potential fire hazards can often be accomplished through greater client education with relatively limited resource expenditures. Installation of fire extinguishers shall be allowed on a limited case-by-case basis in dwellings where compliant solid-fuel burning appliances (wood, pellet, or coal) are present and where the extinguishers provided are appropriate for the purpose intended.

2.0100.1n	Fire safety	Ignition sources will be identified and eliminated (e.g., turn off pilot lights and fuel supply) Use of flammable material will be reduced and fire-rated materials will be used	Prevent a fire hazard
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5631 Smoke Alarms

Smoke detectors that meet the following criteria shall be installed in all dwellings:

- A) In each sleeping room.
- B) Outside each separate sleeping area in the immediate vicinity of the bedrooms.
- C) On each additional story of the dwelling, including basements and habitable attics (finished) but not including crawl spaces, uninhabitable (unfinished) attics and uninhabitable (unfinished) attic- stories. In dwellings or dwelling units with split levels **and** without an intervening door between the adjacent levels, a smoke alarm installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.

Not less than one properly functioning smoke alarm shall be present on each level of a weatherized dwelling. Devices shall be equipped with a 10-year lithium ion battery. Existing smoke alarms that are functioning properly at the time of the initial audit shall not be replaced.

Excepting instances where the Installation Standards shall conflict with manufacturer specifications or local code requirements, smoke alarms shall be installed at the optimal height as specified by the device manufacturer.

As of the effective date of the Installation Standards, NC WAP is unaware of any combination unit that meets the minimum applicable standards for both smoke and carbon monoxide alarms. Combination smoke/carbon monoxide alarms that meet the minimum standards for both devices (should such devices be become available in the future) shall be allowable.

Weatherization service providers shall ensure that clients are well educated on the operation of any smoke alarm installed as well as on appropriate safety precautions to take, should an alarm occur.

2.0301.1b	Smoke alarm (battery operated)	Battery operated alarms will be installed in accordance with the 2012 IRC and manufacturer specifications	Ensure proper installation
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5640 Electrical Hazards

A) Knob and Tube Wiring

Knob and tube wiring present in a weatherization-eligible dwelling shall be inspected by a licensed electrician prior to any weatherization work being performed in the affected area. Actions required to ensure code compliance, as well as occupant and weatherization personnel safety when working in areas with existing knob and tube wiring, may include full or partial replacement.

A licensed electrician shall inspect each dwelling component (attic, walls, and floor) where knob and tube wiring is present and shall document in writing the condition of the wiring observed. The electrician shall further make a determination certifying any action required in order for weatherization work (including insulation) to safely proceed. If a licensed electrician determines, based on conditions observed or applicable local code requirements, that the knob and tube wiring or any portion thereof must be replaced, and replacement of the wiring is cost prohibitive based on applicable health and safety expenditure guidelines and resources available, no insulation shall be installed in the areas where the knob and tube wiring is located; however, air sealing and related work may still be performed. The energy efficiency measures, excluding the attic insulation, must be cost justified using the Weatherization Assistant to ensure the rest of the measures are cost effective.

Copies of electrical inspections and certifications shall be provided to the property owner, be posted at the dwelling where required by code, and shall be maintained in the job file.

2.0601.1a	Knob and tube identification	Contractor, assessor, auditor, or similar will inspect and assess the house to identify knob and tube wiring	Ensure occupant safety Preserve the integrity and safety of the house
2.0601.1b	Live wire testing	Non-contact testing method will be used to determine if wiring is live	Protect occupant safety Preserve the integrity and safety of the house
2.0601.1c	Isolation and protection	Live knob and tube will not be covered or surrounded; required by the National Electrical Code (NEC) or authority having jurisdiction A licensed electrical contractor will inspect and certify wiring to be safe and place a warning at all entries to the attic about the presence of knob and tube wiring	Ensure occupant safety Preserve the integrity and safety of the house

2.0601.1d	Replacement	Exposed wiring will be replaced with new appropriate wiring in accordance with the NEC and local codes Old wiring will be rendered inoperable by licensed electrician in accordance with the NEC and local codes	Ensure occupant safety Preserve the integrity and safety of the house
4.1001.2a	Identifying knob and tube wiring	Contractor, assessor, auditor, or similar will inspect and assess the house to identify knob and tube wiring	Determine if knob and tube wiring exists
4.1001.2b	Testing to determine if live	Non-contact testing method will be used to identify live wiring	Ensure safety of occupants, workers, and house Plan where remediation is needed
4.1001.2c	Isolate or replace	Live knob and tube will not be covered or surrounded; required by the National Electrical Code (NEC) or authority having jurisdiction A licensed electrical contractor will inspect and certify wiring to be safe and place a warning at all entries to the attic about the presence of knob and tube wiring Knob and tube wiring will be replaced with new appropriate wiring by a licensed electrician in accordance with local codes Remaining knob and tube wiring will be rendered inoperable by licensed electrician in accordance with local codes	Ensure work can be completed safely Protect occupant and house Ensure future work can be done safely Prevent the overheating of the wiring

B) Junction Boxes

Electrical connections throughout the weatherized dwelling, where exposed, shall be placed inside covered, code compliant, electrical junction boxes. The location of junction boxes shall be flagged when concealed beneath insulation or other weatherization materials or measures.

C) Aluminum Wiring

Dwellings constructed between 1965 and 1973 must be inspected for the presence of single strand aluminum wire. Aluminum wiring can combine with the oxygen in the air and form a coating on the wire that resists the flow of electricity. This resistance can cause the wires to overheat which may lead to a fire. Aluminum wiring can be identified in the following ways:

- The color of aluminum (whitish in color);
- Wiring-device binding terminals are CO/ALR, which stands for "copper/aluminum revised."; or
- "Aluminum" or the initials "AL" are printed in embossed letters the plastic wire jacket.

If a licensed electrician determines that aluminum wiring is present, it shall be either replaced or repaired if insulation shall be installed. Aluminum wiring may be addressed in the following ways:

- Complete replacement with copper wire
- COPALUM Repair - The COPALUM connector is a system that includes a metal sleeve intended to be installed with a dedicated power tool and crimping die to make a permanent, low-resistance, and safe electrical connection. The repair shall include **every** connection or splice involving aluminum wire in the home, including outlets, dimmers, switches, fixtures, appliances, and junction boxes.

Only electricians who are trained by the manufacturer to use the tool properly are authorized to install COPALUM connectors. To locate a COPALUM installer, visit:
http://inspectapedia.com/electric/Electricians_Directory.php#NC.

Non-COPALUM Crip Connectors, Twist-on Connectors, and CO/ALR switch replacements **are not** acceptable repair procedures. If repair or replacement of the wiring is cost prohibitive based on applicable

health and safety expenditure guidelines and resources available, no insulation shall be installed in the areas where the aluminum wiring is present; however, air sealing and related work may still be performed.

2.0100.1d	Electrical safety	<p>An electrical safety assessment will be performed</p> <p>All electric tools will be protected by ground-fault circuit interrupters (GFCI)</p> <p>Three-wire type extension cords will be used with portable electric tools</p> <p>Worn or frayed electrical cords will not be used</p> <p>Water sources (e.g., condensate pans) and electrical sources will be kept separate</p> <p>Metal ladders will be avoided</p> <p>Special precautions will be taken if knob and tube wiring is present</p> <p>Aluminum foil products will be kept away from live wires</p>	Avoid electrical shock and arc flash hazards
2.0111.2b	Electrical hazards	Electrical hazards will be eliminated and inspected in accordance with NFPA 70 National Electric Code	Ensure site is safe and ready for upgrade

5650 Materials Containing Asbestos

Asbestos is the name given to a naturally occurring group of minerals composed of tiny, easily inhaled fibers. Many common building materials, particularly those installed before the late 1970's, may contain asbestos. See chart below. Weatherization work may disturb building materials containing asbestos. Such disturbances can result in the production of dust containing asbestos (friable asbestos) which may contaminate a structure.

List of Suspect Asbestos Containing Materials	
Cement Pipes	Pipe Insulation (corrugated air-cell, block, etc.)
Cement Wallboard	HVAC Duct Insulation
Cement Siding	Boiler Insulation
Asphalt Floor Tile	Vinyl Wall Coverings
Vinyl Floor Tile	Ductwork Flexible Fabric Connections
Vinyl Sheet Flooring	Spackling Compounds
Flooring Backing	Joint Compounds
Construction Mastics (floor tile, carpet, ceiling tile, etc.)	Heating and Electrical Ducts
Acoustical Plaster	Electrical Panel Partitions
Decorative Plaster	High Temperature Gaskets
Textured Paints/Coatings	Electric Wiring Insulation
Packing Materials (for wall/floor penetrations)	Roofing Shingles
Spray-Applied Insulation	Roofing Felt
Vermiculite Blown-in Insulation	Base Flashing
Wallboard	Caulking/Putties
Taping Compounds (thermal)	Adhesives

Weatherization service providers shall be responsible for ensuring weatherization personnel, including subcontractor staff, possess adequate training and knowledge to enable them to properly identify asbestos

encountered during initial dwelling audits and appropriately handle suspected asbestos containing materials (ACM). Weatherization personnel shall be required to successfully complete Occupational Safety and Health Administration's Operations and Maintenance 16 hour course. In order to maintain compliance, an 8 hour refresher course must be taken every fiscal year.

Where asbestos is suspected, weatherization service providers shall ensure that all weatherization program services subsequently provided comply with applicable state regulations as specified by the North Carolina Asbestos Hazard Management Program (AHMP) administered by the Health Hazards Control Unit (HHCU) and applicable local codes. Where the AHMP regulations and applicable local codes conflict, the more stringent standard shall govern. The AHMP shall be consulted for information on the management of asbestos-containing materials and can be reached at (919) 707-5950 or <http://www.epi.state.nc.us/epi/asbestos/ahmp.html>.

Asbestos measures undertaken in compliance with state and local regulations shall be limited in scope. Asbestos testing, encapsulation, or removal activities shall be restricted to only the scale or scope required to provide for safe installation of weatherization measures. For example, removal of a limited portion of exterior siding material to allow for safe installation of a properly vented range hood exhaust fan shall be allowed. Removal of the exterior siding material from an entire dwelling shall not be allowed. The scope of allowable asbestos management measures shall, additionally, not exceed the following limits:

- A) Siding/Ceiling/Wall Coverings – removal and replacement of materials where performed by an appropriately trained Operations and Maintenance worker or Asbestos Hazard Emergency Response Act of 1986 (AHERA) certified asbestos control professional*
- B) Vermiculite – testing and encapsulation where *performed* by an appropriately trained or AHERA certified asbestos control professional. Removal shall not be allowed. Blower door testing is discouraged. Where performed, pressurization rather than depressurization shall be mandated*
- C) Ducts/Pipes/Furnaces/Other – testing, encapsulation, or removal is allowable where performed by an AHERA certified asbestos control professional.*

*Material categories specified in items A-C of this section shall be treated as containing asbestos unless testing conclusively determines otherwise.

2.0100.1o	Asbestos-containing materials (ACM)	<p>Assess potential asbestos hazard; if unsure whether material contains asbestos, contact a qualified asbestos professional to assess the material and to sample and test as needed</p> <p>If suspected ACM is in good condition, do not disturb</p> <p>If suspected ACM is damaged (e.g., unraveling, frayed, breaking apart), immediately isolate the area(s)</p> <p>For suspected ACM that is damaged or that must be disturbed as part of the retrofit activity, contact an asbestos professional for abatement or repair in accordance with federal, state, and local requirements; only a licensed or trained professional may abate, repair, or remove ACM</p> <p>When working around ACM, do not:</p> <ul style="list-style-type: none"> • Dust, sweep, or vacuum ACM debris • Saw, sand, scrape, or drill holes in the material • Use abrasive pads or brushes to strip materials <p>Asbestos abatement or repair work should be completed prior to blower door testing; exercise appropriate caution when conducting blower door testing where friable asbestos or vermiculite attic insulation is present to avoid drawing asbestos fibers into the living space (i.e., use positively pressurized blower door testing) unless the material has been tested and found not to contain asbestos</p>	Protect workers and occupants from potential asbestos hazards
2.0105.2c	Asbestos	Identify asbestos hazards in boiler and pipe insulation and remediate in accordance with EPA guidelines	Protect workers and occupants from asbestos exposure
2.0105.4c	Asbestos	<p>Suspected asbestos hazards will be identified in furnaces (e.g., gaskets), wood stoves, zonal heating devices, electrical wiring insulation, boilers, and pipe insulation and corrected in accordance with EPA guidance</p> <p>Workers will take precautionary measures to avoid exposure</p>	Protect worker and occupant from asbestos exposure

5660 Lead Dust Exposure

Common construction-related activities including, but not limited to, sanding, cutting, and demolition can create hazardous lead dust and chips by disturbing lead-based paint, which can be harmful to adults and children.

To reduce potential lead exposure risks, organizations performing renovation, repair, and painting projects that disturb lead-based paint in site built dwellings built before 1978 shall be certified and shall follow specific work practices to prevent lead contamination.

A) Renovate Right

Weatherization service providers shall be responsible for compliance with the Environmental Protection Agency's (EPA) Lead RRP Rule; "Lead Hazard Information Pamphlet"; Notice of Availability; Final Rule, and with the requirements of the EPA's "Renovate Right: Important Lead Hazard Information for Families, Child Care Providers, & Schools" publication.

All site build dwellings built prior to 1978 can be *assumed* to contain lead-based paint and require compliance with lead-safe work practices wherever weatherization measures with the potential to disturb lead-based paint shall be performed in such dwellings. Site built dwellings may be tested for lead-based paint using one of two readily available EPA recognized RRP compliant test kits. Please note that *De minimus* lead levels shall not be recognized.

- a) **3M™ LeadCheck™** - The EPA recognizes that the 3M™ LeadCheck™ lead test kit can reliably determine that regulated lead-based paint is not present on wood, ferrous metal (alloys that contain iron), or drywall and plaster surfaces.

- b) **D-Lead®**. The EPA recognizes that the D-Lead® paint test kit can reliably determine that regulated lead-based paint is not present on wood, ferrous metal (alloys that contain iron), or drywall and plaster surfaces.

Weatherization service providers shall further be responsible for complying with mandatory documentation requirements for lead-safe work practices including, but not limited to, photographic documentation of jobsite and containment set up, waste disposal, a listing of materials used and measures performed, and identification of the certified lead renovator assigned to the job. Clean up procedures and documentation is required when using test kits.

B) Lead-Safe Weatherization

Lead-safe weatherization (LSW) is a set of protocols based on federal EPA and Occupational Safety and Health Administration (OSHA) regulations, applied when disturbing surfaces that may contain lead-based paint, and is intended to reduce and control the amount of lead dust and paint chips generated. LSW shall apply to all weatherization services providers administering the WAP and specific training shall be required.

While LSW should not be confused with the EPA's RRP Rule, for the purposes of compliance with the Installation Standards compliance with the RRP Rule, any additional NC WAP guidance, and local codes shall constitute compliance with LSW protocols.

2.0100.1p	Lead paint assessment	<p>Presence of lead based paint in pre-1978 homes will be assumed unless testing confirms otherwise</p> <p>The Environmental Protection Agency (EPA) Renovation, Repair, and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards; see http://www.epa.gov/lead/pubs/renovation.htm</p>	Protect workers and occupants from potential lead hazards
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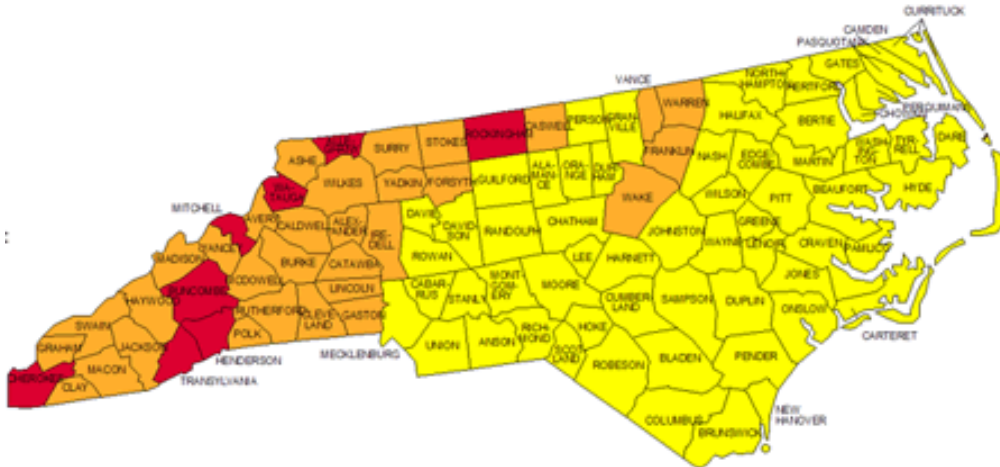
5670 Radon Gas

Radon is a naturally occurring, colorless, odorless, tasteless, cancer-causing, radioactive gas found throughout the United States and can permeate the walls of any building type. Radon can only be confirmed by testing, which is generally inexpensive and noninvasive.

The EPA is charged with identifying areas of the United States with an increased potential for elevated indoor radon levels, and small portions of Western and Central North Carolina have been designated as "Radon Risk Areas". Weatherization service providers shall consult the EPA's website at <http://www.epa.gov/radon/states/northcarolina.html> for further information. A map of the EPA's designated Radon Risk Zones to identify impacted counties is below.

Allowable radon safety measures include testing, client education, and compliant vapor barrier installation in NC counties designated as either:

- A) Red - High Potential Radon Risk Area (*testing recommended*)
- B) Orange - Moderate Potential Radon Risk Area (*testing allowable*).



Weatherization service providers serving radon risk areas shall be responsible for educating clients on the potential presence of radon, associated health conditions, results from testing performed on the dwelling, and living conditions that may contribute to higher radon concentrations.

2.0501.1a	Radon testing and mitigation	Radon testing will be done in accordance with the Environmental Protection Agency (EPA) Healthy Indoor Environment Protocols for Home Energy Upgrades	Reduce potential for occupant exposure to radon
2.0501.2a	Radon testing and mitigation	Radon testing will be done in accordance with the Environmental Protection Agency (EPA) Healthy Indoor Environment Protocols for Home Energy Upgrades	Reduce potential for occupant exposure to radon

5700 Mold and Moisture Remediation

Mold and mildew can pose serious potential health hazards for dwelling occupants. Weatherization service providers shall be responsible for ensuring steps are taken to alleviate moisture problems wherever feasible. All weatherization-eligible dwellings shall be inspected at the time of initial audit to determine that only minor moisture damage or mold growth, if any, is present. Where severe mold or moisture problems exist, the dwelling shall be deferred until such time as the conditions can be corrected.

Visual assessment as well as diagnostics techniques such as the use of moisture meters shall be recommended both at the time of the initial audit and again during the final inspection. Mold testing shall not be allowed.

5710 Mold and Moisture Treatment Limitations

Where existing mold growth is determined to affect greater than 10 ft.² of surface area within a dwelling interior, crawl space, or attic, the dwelling shall be placed in deferral status and no weatherization program services shall be provided. Where areas of 10 ft.² or fewer exist and treating the mold is necessary in order to weatherize the home and to ensure the long term stability and durability of measures, the affected area shall be treated prior to proceeding with any subsequent weatherization work.

Every individual remaining in the work area during treatment shall be equipped with a minimum N-95 respirator, leak-proof eye protection, and protective gloves and clothing. The work area shall be well ventilated and the mold-affected area shall be scrubbed clean using a brush, water, and a household detergent.

2.0111.2c	Mold	Appropriate remediation will be completed before upgrade	Ensure site is safe and ready for upgrade
2.0401.1a	Moisture precautions for attics	Roof leaks will be repaired before performing attic air sealing or insulation Moisture sources in the house that can generate moisture into the attic will be identified and removed or reduced	Ensure durability of repairs Reduce potential for occupant exposure to mold and other moisture-related hazards Prevent moisture from communicating from within the conditioned space into unconditioned attic space when economically feasible
2.0401.1c	Moisture precautions for the living space	Moisture sources in the home will be identified and removed or reduced Local ventilation will be installed where appropriate (e.g., baths, kitchens) and vented to outside according to ASHRAE 62.2 Unvented combustion appliances that are not listed to ANSI Z21.11.2 will be removed	Ensure durability of repairs Reduce potential for occupant exposure to mold and other moisture-related hazards

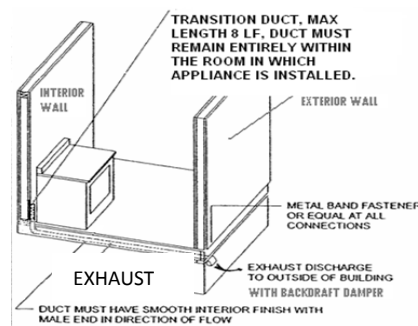
5720 Dryer Exhaust Venting

Exhaust venting for clothes dryers shall be installed or repaired as needed to ensure that warm, moist air exhausted during the drying cycle is properly vented to the outdoors in every dwelling weatherized. Dryer exhaust venting shall:

- A) Move moisture beyond the perimeter of the dwelling (crawl space, basement, other)
- B) Consist of transitional duct of flexible metal that is no more than 8 linear ft.
- C) Consist of rigid, insulated metal pipe outside the conditioned area in which the dryer is located.
- D) Be as straight as possible and span the minimum length required to exit the exterior of the dwelling, but shall never exceed 35 ft.
- E) Be properly supported
- F) Be fitted with an outdoor hood and backflow damper
- G) Not contain more than two total elbows (each 90-degree elbow shall count as 5 ft. of run length for a 4 in. radius duct and shall count for 1 ft. 9 in. for a 6 in. radius duct)
- H) Not consist of sections secured using screws.

Dryer Exhaust Venting Exiting Through Exterior Wall Diagram

Dryer exhaust venting exiting the dwelling through crawl space vents shall pass completely through the vent opening, be fitted with a draft hood and backflow damper, and any excess space remaining at the opening shall be filled with a rigid sheet-good and sealed to prevent moisture from blowing back into the crawl space.



6.6005.1a	Clothes dryer ducting	<p>Clothes dryers will be ducted to the outdoors, which does not include unconditioned spaces such as attics and crawl spaces that are ventilated with the outdoors</p> <p>As short a run as practical of rigid sheet metal or semi-rigid sheet metal venting material will be used in accordance with manufacturer specifications</p> <p>Dryer ducts exceeding 35' in duct equivalent length will have a dryer booster fan installed</p> <p>Plastic venting material will not be used</p> <p>Uninsulated clothes dryer duct will not pass through unconditioned spaces such as attics and crawl spaces</p> <p>Ducts will be connected and sealed as follows:</p> <ul style="list-style-type: none"> • UL listed foil type or semi-rigid sheet metal to rigid metal will be fastened with clamp • Other specialized duct fittings will be fastened in accordance with manufacturer specifications • In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material <p>In addition:</p> <ul style="list-style-type: none"> • Sheet metal screws or other fasteners that will obstruct the exhaust flow will not be used • Condensing dryers will be plumbed to a drain 	<p>Preserve integrity of building envelope</p> <p>Effectively move air from clothes dryer to outside</p>
6.6005.1b	Termination fitting	<p>Termination fitting manufactured for use with dryers will be installed</p> <p>A backdraft damper will be included, as described in termination fitting detail</p>	<p>Preserve integrity of building envelope</p> <p>Effectively move air from clothes dryer to outside</p>
6.6005.1c	Make-up air	<p>Make-up air will be provided for appliances exhausting more than 200 CFM</p>	<p>Preserve integrity of building envelope</p> <p>Effectively move air from clothes dryer to outside</p>
6.6005.1d	Combustion safety	<p>Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards</p>	<p>Ensure safe operation of combustion appliances</p> <p>Ensure occupant health and safety</p>
6.6005.1e	Occupant education	<p>Occupant will be instructed to keep lint filter and termination fitting clean</p> <p>Occupant will be instructed to keep dryer booster fan clean, if present</p> <p>Occupant will be instructed on clothes dryer operation safety including information on items that must not be placed in the clothes dryer (items with any oil or other flammable liquid on it, foam, rubber, plastic or other heat-sensitive fabric, glass fiber materials)</p>	<p>Effectively move air from clothes dryer to outside</p>

5730 Vapor Barriers

A continuous vapor barrier shall be installed in all enclosed, accessible, exposed earth crawl spaces beneath conditioned space to prevent the diffusion of soil moisture into the dwelling or building materials. Vapor barriers shall not be installed under porches. Vapor barriers shall be installed after air sealing and floor insulation have been installed. Vapor barriers installed shall:

- A) Consist of not less than a 6 mil polyethylene sheet-material;
- B) Be opaque or non-translucent to decrease UV light transmittance that may promote material-deteriorating conditions beneath the barrier;
- C) Extend up the foundation walls not less than 6 in. If less than 100% of the crawl space is accessible, extending the vapor barrier up the foundation wall shall not be required, however; all accessible exposed ground shall be covered with the vapor barrier. Please note that the foundation piers **shall not** be covered;
- D) Be continuous with upslope overlapping unsealed seams of not less than 12 in.

2.0401.1b	Moisture precautions for crawl spaces	Exposed earth will be covered with a continuous, durable, sealed Class 1 vapor retarder a minimum of 6 mil in thickness Plastic, foil or any other Class 1 vapor barrier/retarder will not be used in hot-humid climates All accessible penetrations between the crawl space or basement and outside will be sealed Holes between the crawl space or basement and the living space will be sealed	Ensure durability of repairs Reduce potential for occupant exposure to mold and other moisture-related hazards
2.0402.1d	Interior grading	Interior grading will be sloped to one or more collection points, if possible	Collect interior water for removal
2.0403.1a	Scheduling	The ground moisture barrier will be installed last	Protect ground moisture barrier from damage during other crawl space work
2.0403.1b	Coverage	A ground moisture barrier that covers 100% of the exposed crawl space floor will be installed	Reduce ground moisture entering the crawl space
2.0403.1c	Material specification	A ground moisture barrier with a rating of no more than 0.1 perm will be used A minimum expected service life of 10 years will be ensured A ground moisture barrier will be used that meets tear and puncture resistance standard ASTM D703	Ensure crawl space is accessible for service and maintenance without damaging the integrity of the ground moisture barrier
2.0403.1d	Overlap seams	When seams exist, they will be overlapped a minimum of 12" using "reverse" or "upslope lapping" technique	Keep water under the liner Reduce the likelihood of damage at seams
2.0403.1e	Fastening	Ground moisture barrier will be fastened to ground with durable fasteners or ballast(s) and extend a minimum of 6" up the foundation wall unless 100% of the ground cannot be covered. In these cases, the ground moisture barrier will be deployed to accessible areas but not fastened to the foundation walls. A minimum expected service life of 10 years will be ensured	Prevent movement of the ground moisture barrier

5740 Moisture Diversion

Major drainage issues are beyond the scope of WAP services. Minor repair or installation of gutters, downspouts, drainage extensions, and/or flashing to divert moisture away from the foundation of a weatherized dwelling, as well as corrections to the grade of the landscape and installing trenches shall be allowed on a limited case-by-case basis.

Weatherization service providers shall be responsible for ensuring the use of weatherization program resources to correct drainage-related issues is justified and well documented. A lack of compelling evidence justifying the need for drainage-related work may result in expenditures for such work being disallowed.

2.0401.1d	Moisture precautions for exterior water	Before air sealing basement or crawl space walls near wet areas, surface water pooling near the foundation will be addressed by: <ul style="list-style-type: none"> Repairing, modifying or replacing gutters and downspouts Grading and subsurface drainage at critical locations (e.g., localized drain and grading beneath valleys) in accordance with Environmental Protection Agency (EPA) Indoor airPLUS Construction Specifications Section 1.1 Possible mitigation by waterproofing or installing draining plane with construction adhesive 	Reduce potential for occupant exposure to mold and other moisture-related hazards
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5800 Indoor Air Quality and ASHRAE 62.2-2013

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is an international organization with the mission of advancing heating, ventilation, air conditioning and refrigeration. The American National Standards Institute (ANSI)/ASHRAE Standard 62.2-2013, *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings*, is the only nationally recognized IAQ standard developed solely for residences. It defines the roles of, and minimum requirements for mechanical and natural ventilation systems and the building envelope intended to provide acceptable IAQ in low-rise residential buildings.

All weatherized dwellings up to three stories shall be supplied with adequate whole house mechanical ventilation in compliance with ASHRAE Standard 62.2-2013 (ASHRAE 62.2). Weatherization service providers shall be responsible for ensuring that a properly trained member of weatherization personnel or management determines the accurate calculation of the required rate of ventilation per dwelling for every dwelling weatherized using the following standard equation:

$$Q_{fan} = [(0.03 \times A_{floor}) + 7.5 \times (N_{br} + 1)] + [.25 \times (CFM_{Fan\ Deficient} - N_w \times 20)] - \left[\frac{(1000 \times (\frac{CFM_{50}}{2618.28}) \times [\frac{H}{8.2}]^{0.4}) \times wsf}{7.3} \right]$$

Where

Q_{tot}	= Calculated required continuous flow rate in CFM
A_{floor}	= Heated floor area in ft ²
N_{br}	= Number of bedrooms (cannot be less than 1)
$CFM_{Fan\ Deficient}$	= Total amount of airflow from missing or underperforming local exhaust fans
N_w	= Number of operable windows located where there is spot ventilation
CFM_{50}	= Blower door reading at -50 pascals
H	= Vertical distance between the lowest and highest points in the pressure boundary
wsf	= weather and shielding factor from chart below

Weather and Shielding Factor			
wsf	Weather Station	wsf	Weather Station
0.47	Asheville Regional Arpt	0.40	Hickory Regional AP
0.49	Cape Hatteras Nws Bldg 35.27	0.43	Jacksonville (AWOS)
0.43	Charlotte Douglas Intl Arpt	0.44	Kinston Stallings AFB
0.46	Cherry Point MCAS	0.41	New Bern Craven Co Regl AP
0.5	Dare Co Rgnl	0.43	New River MCAF
0.50	Elizabeth City Coast Guard Ai [Nrel]	0.40	Pitt Greenville Arp
0.43	Fayetteville Pope AFB	0.43	Raleigh Durham International
0.44	Fayetteville Rgnl G	0.42	Rocky Mount Wilson
0.38	Fort Bragg Simmons AAF	0.41	Southern Pines AWOS
0.44	Goldsboro Seymour Johnson AFB	0.43	Wilmington International Arpt
0.43	Greensboro Piedmont Triad Int	0.39	Winston-Salem Reynolds AP

5810 Ventilation Device Categories

Devices installed to achieve compliant mechanical exhaust ventilation levels shall include a combination of intermittent whole house ventilation (WHV) and local exhaust ventilation (LEV) fans. An LEV fan may be used to help achieve compliant WHV where the LEV is rated for use with a timer and is under 1 sone.

Category A. Fans All kitchens containing a fuel-fired range shall be equipped with a LEV fan rated at less than 3.0 sones, with an installed airflow rate of not less than 100 cubic feet per minute (CFM) but not greater than 200 CFM. A range hood fan is recommended wherever feasible, but shall not be required. To increase the probability of uniform compliance with this standard, devices installed in kitchens shall have a rated airflow, specified by the device manufacturer, of not less than 120 CFM.

6.6005.2a	Wiring	Wiring will be installed in accordance with local regulations or the 2012 IRC in the absence of such regulations or where those regulations are not as stringent as the 2012 IRC Wiring will be installed in accordance with original equipment manufacturer specifications and local and national electrical and mechanical codes	Prevent an electrical hazard
6.6005.2b	Fan venting	Kitchen range fans will be vented to the outdoors Re-circulating fans will not be used as a ventilating device	Remove cooking contaminants from the house Preserve integrity of building envelope
6.6005.2c	Fan ducting	Kitchen range fans will be ducted to the outdoors As short a run as practical of smooth wall metal duct will be used, following manufacturer specifications Ducting will be connected and sealed as follows: <ul style="list-style-type: none"> • Metal-to-metal will be fastened with a minimum of three equally spaced screws • Other metal-to-metal connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes • For down-draft exhaust systems, PVC-to-PVC materials will be fastened with approved PVC cement • Other specialized duct fittings will be fastened in accordance with manufacturer specifications • In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material 	Preserve integrity of building envelope Effectively move air from range to outside
6.6005.2d	Termination fitting	Termination fitting will be installed including a backdraft damper, as described in termination fitting detail	Ensure safe operation of combustion appliances Ensure occupant health and safety
6.6005.2e	Make-up air	Make-up air will be provided for kitchen range fans exhausting more than 200 CFM	Ensure safe operation of combustion appliances Ensure occupant health and safety
6.6005.2f	Combustion safety	Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards	Ensure safe operation of combustion appliances Ensure occupant health and safety
6.6005.2g	Occupant education	Occupant will be instructed to keep grease filters and termination fitting clean	Effectively move air from kitchen range to outdoors

Category B. Fans At least one full bathroom in every dwelling shall be equipped with a timer-equipped WHV fan with a sone rating of 1.0 or less and an installed airflow rate of not less than 50 CFM. If the projected continuous fan flow at the time of the energy audit and the final continuous fan flow requirement at the time of final inspection are equal to or less than 15 CFM, then a Category B fan **shall not** be required.

- A) To increase the probability of uniform compliance with this standard, devices installed in bathrooms shall have a rated airflow specified by the device manufacturer of not less than 70 CFM.
- B) Where two or more full bathrooms are present, *Category B. Fans* shall be located in the full bathroom located in closest proximity to the main living area.
- C) When the fan exhaust duct is outside the conditioned space, *Category B. Fans* shall be insulated to R-4. Ducts shall be installed so as to minimize sagging. While smooth, hard metal pipe is optimal, flexible duct is acceptable.
- D) Flex duct shall have a 5 in. diameter minimum; use the same diameter size for duct and hood/termination kits (do not use a reducer to the termination kit).
- E) No more than two elbows shall be used. Where possible, elbows shall be of a long radius design.
- F) Ducts shall be installed with the shortest possible run to minimize static pressure. While roof venting is preferred, venting through gable siding, gable vents and soffit vents is allowed so long as the termination is properly installed to avoid crimping.

6.6002.3a	Primary whole house ventilation	Fan intake grille will be installed in a central location within the main body of the house Ensure it is accessible for filter change and cleaning	Provide whole house air exchange
6.6002.3b	Local ventilation	Fan intake grille will be installed in the space where odor, moisture vapor, or other contaminants are generated	Remove contaminated air at the source
6.6201.1c	Single additional fan to meet all ventilation requirements	Air flows will be measured and adjusted to meet the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction. See Calculation of the Infiltration Credit for calculation information and examples	Provide sufficient flows in accordance with current ventilation standards

Surface Mounted Ducted Fans			
6.6003.1a	Hole through interior surface	A hole no greater than a 1/4" greater than the assembly will be cut to accommodate fan assembly	Minimize repair work Ensure a secure installation
6.6003.1b	Wiring	Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes	Prevent an electrical hazard
6.6003.1c	Fan mounting	Fan outlet will be oriented toward the final termination location Fan will be oriented so the equivalent length of the duct run is as short as possible Fan will be mounted securely in accordance with manufacturer specifications	Ensure short duct run to achieve optimum air flow Ensure a secure installation Ensure fan housing does not shake, rattle, or hum when operating
6.6003.1d	Backdraft damper	A backdraft damper will be installed between the outlet side of the fan and the exterior	Prevent reverse air flow when the fan is off
6.6003.1e	Duct to fan connection	Duct-to-fan outlet will be connected and sealed as follows: <ul style="list-style-type: none"> Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool PVC-to-PVC materials will be fastened with approved PVC cement Other specialized duct fittings will be fastened according to manufacturer specifications In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material 	Exhaust to outside
6.6003.1f	Fan housing seal	Gaps and holes in fan housing will be sealed with caulk or other sealants in accordance with manufacturer recommendations Sealants will be compatible with their intended surfaces Sealants will be continuous and meet fire barrier specifications	Prevent air leakage through fan housing Ensure a permanent seal Prevent a fire hazard

6.6003.1g	Fan to interior surface seal	Sealants will be compatible with their intended surfaces Sealants will be continuous and meet fire barrier specifications	Prevent air leakage between house and fan
6.6003.1h	Air flow	Air flows in cubic feet per minute (CFM) will be measured and adjusted to meet the whole house upgrade design requirements	Exhaust sufficient air from desired locations to outside
6.6003.1i	Preventing air leakage caused by exhaust fans	Leakage to the house from other spaces will be prevented (e.g., garages, unconditioned crawl spaces, unconditioned attics)	Ensure occupant health and safety
6.6003.1j	Combustion safety	Pressure effects will be assessed and corrected on all combustion appliances	Ensure safe operation of combustion appliances

Through the Wall Fans			
6.6003.3a	Hole in building shell	A hole no greater than a 1/4 inch greater than the assembly will be cut to accommodate fan assembly	Allow for ease of weatherproofing
6.6003.3b	Wiring	Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes	Prevent an electrical hazard
6.6003.3c	Fan mounting	Fan outlet will be oriented toward the final termination location Fan will be oriented so the equivalent length of the duct run is as short as possible Fan will be mounted securely according to manufacturer specifications	Install mounting fan securely Ensure fan housing does not shake, rattle, or hum when operating
6.6003.3d	Weatherproof installation	Exterior termination fitting will be flashed or weather sealed Water will be directed away from penetration Termination fitting installation will not inhibit damper operation Manufacturer specifications will be followed	Preserve integrity of the building envelope Ensure a weather tight and durable installation Ensure unrestricted air flow
6.6003.3e	Backdraft damper	A backdraft damper will be installed between the outlet side of the fan and the exterior	Prevent reverse air flow when the fan is off
6.6003.3f	Fan housing seal	Sealants will be compatible with their intended surfaces Sealants will be continuous and meet fire barrier specifications	Prevent air leakage through fan housing Ensure a permanent seal to the building air barrier
6.6003.3g	Fan to interior surface seal	Sealants will be compatible with their intended surfaces Sealants will be continuous and meet fire barrier specifications	Prevent air leakage around intake housing Prevent a fire hazard
6.6003.3h	Insulation	All components outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local code Exception: If system operates continuously, fan housing need not be insulated	Preserve integrity of the duct system
6.6003.3i	Air flow	Air flows in CFM will be measured and adjusted to meet the design requirements	Exhaust sufficient air from desired locations to outside
6.6003.3j	Preventing air leakage caused by exhaust fans	Leakage to the house from other spaces will be prevented (e.g., garages, unconditioned crawl spaces, unconditioned attics)	Ensure occupant health and safety
6.6003.3k	Combustion safety	Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards Exhaust fans and other exhausting systems shall be provided with makeup air or other pressure relief	Ensure safe operation of combustion appliances

Terminations			
6.6002.2a	Hole in building shell	A hole no greater than a 1/4" greater than the fitting will be cut to accommodate termination fitting	Allow for ease of weatherproofing
6.6002.2b	Termination fitting	A termination fitting with an integrated collar will be used Collar will be at least the same diameter as the exhaust fan outlet; if collar is larger than exhaust fan outlet, a rigid metal transition will be used Fitting will be appropriate for regional weather conditions and installation location on house so as not to be rendered inoperable	Effectively move the required volume of air to the outside Preserve integrity of the building envelope Ensure durable installation

6.6002.2c	Duct to termination connection	<p>Duct will be connected and sealed to termination fitting as follows:</p> <ul style="list-style-type: none"> Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool PVC-to-PVC materials will be fastened with approved PVC cement Other specialized duct fittings will be fastened in accordance with manufacturer specifications In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material <p>Fasteners will not inhibit damper operation</p>	<p>Effectively move the required volume of air to the outside</p> <p>Preserve integrity of the building envelope</p> <p>Ensure durable installation</p>
6.6002.2d	Weatherproof installation	<p>Exterior termination fitting will be flashed or weather sealed</p> <p>Water will be directed away from penetration Installation will not inhibit damper operation Manufacturer specifications will be followed</p>	<p>Preserve integrity of the building envelope</p> <p>Ensure a weather tight and durable termination installation</p> <p>Ensure unrestricted air flow</p>
6.6002.2e	Pest exclusion	<p>Screen material with no less than ¼" and no greater than ½" hole size in any direction will be used</p> <p>Installation will not inhibit damper operation or restrict air flow</p>	<p>Prevent pest entry</p> <p>Ensure proper air flow</p>
6.6002.2f	Termination location	<p>Terminations will be installed:</p> <ul style="list-style-type: none"> A minimum of 3' away from any property line A minimum of 3' away from operable opening to houses A minimum of 10' away from mechanical intake As required by authority having jurisdiction 	Prevent exhaust from reentering house
6.6002.2g	Kitchen exhaust	Galvanized steel, stainless steel, or copper will be used for termination fitting for kitchen exhaust	Prevent a fire hazard

Controls			
6.6202.1a	Primary ventilation fan (whole-house volume)	<p>Controls will be used that can meet the following conditions:</p> <ul style="list-style-type: none"> Run fan continuously or intermittently depending upon the intended schedule of operation Operate fan to produce the intended flow for each intended flow setting 	<p>Deliver intended air exchange</p> <p>Ensure fan controls meet intended ventilation strategy</p>
6.6202.1b	Local exhaust—local fan	<p>Controls will be used that meet the following conditions:</p> <ul style="list-style-type: none"> Run fan continuously or intermittently depending on the intended schedule of operation Run fan for intended time for timed operation Operate fan to produce the intended flow for each intended flow setting 	<p>Deliver intended air exchange</p> <p>Ensure fan controls meet intended ventilation strategy</p>
6.6202.1c	Wiring	Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes	<p>Prevent an electrical hazard</p> <p>Ensure fan controls meet intended ventilation strategy</p>
6.6202.1d	Manual override	A labeled switch for manual override will be included for the ventilation system	Ensure fan controls meet intended ventilation strategy
6.6202.1e	Occupant education	<p>A system operation guide designed for occupants (non-professionals) will be provided to explain how and why to operate system</p> <p>A label indicating the presence and purpose of the ventilation system will be included or a copy of the system operation guide will be posted at the electrical panel</p>	<p>Educate occupants about system operation and importance</p> <p>Deliver intended air exchange</p>

Category C. Fans

While only the Category B. Fans are required in every dwelling, a LEV fan may be installed in any other full bathroom in which moisture issues are cited. Any remaining full bathroom needing fan installation shall be equipped with an intermittent LEV fan meeting the same minimum CFM and some specifications as *Category B. Fans*. Timers shall not be installed in additional full bathrooms.

Prescriptive Duct Sizing Requirements (Adapted from ASHRAE 62.2 -2013 Table 7.1)

Duct Type	Flex Duct				Smooth Duct			
Fan Rating (CFM @0.25 in. w.c.)	50	80	100	125	50	80	100	125
Maximum Allowable Duct Length (ft.)								
Diameter (in.)	Flex Duct				Smooth Duct			
3	X	X	X	X	5	X	X	X
4	70	3	X	X	105	35	5	X
5	NL	70	35	20	NL	135	85	55
6	NL	NL	125	95	NL	NL	NL	125
7 and above	NL	NL	NL	NL	NL	NL	NL	NL

This table assumes no elbows. Deduct 15 ft. of allowable duct length for each turn, elbow, or fitting.

NL – no limit on duct length of this size

X – not allowed

w.c. – water column

6.6002.1a	Duct design and configuration	Ventilation ducts will be as short, straight, and smooth as possible Ventilation ducts will not be smaller than the connections to which they are attached	Effectively move the required volume of air
6.6002.1b	Duct insulation	Ducts installed outside of the thermal envelope will be insulated to a minimum of R-4 or equivalent to local codes	Prevent condensation from forming or collecting inside of the ductwork
6.6002.1c	Duct support	Flexible and duct board ducts and plenums will be supported every 4' using a minimum of 1 1/2" wide material Support materials will be applied in a way that does not crimp ductwork or cause the interior dimensions of the ductwork to be less than specified (e.g., ceiling, framing, strapping); duct support must be installed in accordance with authority having jurisdiction Metal ducts will be supported by 1/2" or wider 18-gauge strapping or 12 gauge or thicker galvanized wire no less than 10' apart	Effectively move the required volume of air Preserve the integrity of the duct system Eliminate falling and sagging
6.6002.1d	Duct connections	Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic- plus-embedded-fabric systems, or tapes Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool PVC-to-PVC materials will be fastened with approved PVC cement Other specialized duct fittings will be fastened in accordance with manufacturer specifications In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material	Effectively move the required volume of air Preserve the integrity of the duct system
6.6002.1e	Duct materials	Flexible materials will be UL 181 listed or Air Diffusion Council approved Rigid, kitchen fans gauges shall meet code requirements or authority having jurisdiction	Effectively move the required volume of air Preserve the integrity of the duct system

Sound-Rating Limits			
6.6288.1a	Primary ventilation system or any continuously operating fan	System shall be rated for sound at a maximum of 1.0 sone, in accordance with ASHRAE 62.2 standard	Minimize noise

6.6288.1b	Intermittent local ventilation system	Local ventilation will be rated for sound at a maximum of 3 sone, unless their maximum rated airflow exceeds 400 cfm, in accordance with ASHRAE 62.2 standard	Minimize noise
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5820 Ventilation Evaluation and Implementation

Upon completion of all cost-effective air sealing measures, all fans present shall be metered and the need for additional ventilation, if any, shall be determined using applicable diagnostic standards for calculating adequate WHV. Where the need for whole house intermittent ventilation exists, *Category B. Fans* shall be calibrated as needed to provide the required airflow using the standard equation provided to calculate continuous flow, and the following chart to set intermittent fan flow.

NC WAP Intermittent Fan Flow Settings (CFM)										
Metered										
Fan Flow		30	35	40	45	50	55	60	70	80
Continuous Fan Flow (CFM)	Minutes Per Hour									
	5	10	9	8	7	6	5	5	4	4
	10	20	17	15	13	12	11	10	9	8
	15	30	26	23	20	18	16	15	13	11
	20	40	34	30	27	24	22	20	17	15
	25	50	43	38	33	30	27	25	21	19
	30	60	51	45	40	36	33	30	26	23
	35		60	53	47	42	38	35	30	26
	40			60	53	48	44	40	34	30
	45				60	54	49	45	39	34
50					60	55	50	43	38	

Where a functioning fan existing in a kitchen with an electric stove is metered and determined to be performing at less than 100 CFM, efforts shall be made to correct deficiencies in the installation of the fan and venting to increase the flow. Where existing fan or venting cannot be repaired to achieve airflow of at least 100 CFM, such fans may be replaced with *Category A. Fans*. Where a kitchen is missing a fan and it is not feasible to either correct an underperforming fan or install a *Category A. Fan*, the amount of airflow deficiency shall be added to the *Category B. Fan* whole house runtime.

Where functioning fans existing in second or third full bathrooms are metered and determined to be performing at less than 50 CFM, efforts shall be made to correct deficiencies in the installation of the fan and venting to increase the flow. Where existing fans or venting cannot be repaired to achieve airflow of at least 50 CFM, such fans may be replaced with *Category C. Fans*. Where a bath is missing a fan or it is not feasible to either correct the underperforming fan or install a *Category C. Fan*, the amount of airflow deficient shall be added to the *Category B. Fan* whole house runtime.

To the extent practicable, an existing noncompliant fan/light combination shall be replaced with compliant fan/light combination. Fan/light combination devices shall be IC-rated. Devices that specifically include heat as a feature shall not be allowed. Installation of a compliant fan alongside an existing heat/light combination device shall be allowed.

Mechanical exhaust ventilation fans installed shall be installed per manufacturer specifications and with electrical connections performed by a licensed electrician, as required by local, county, or state code. Fan controls shall be installed in the same room as the fan and fans rated for continuous operation shall be controlled by a dedicated switch. Bathroom exhaust venting shall be insulated to a minimum R-4. Kitchen exhaust venting shall be made of a smooth metal duct but shall not be insulated. All fans existing after weatherization shall exhaust to the outdoors. Under **no** circumstances shall installation or repair of recirculating fans be allowed, regardless of location or fuel sources present.

The suspected presence of materials containing asbestos or lead in ceilings or exterior walls shall not constitute justification for failure to comply with ventilation standards. Asbestos Operations and Maintenance training and Lead Safe Weatherization shall be used and documented when suspected materials are present. The presence of a metal roof shall not constitute justification for failure to comply with this standard. Similarly, where moisture issues exist in areas of a dwelling not adequately served by mechanical ventilation as specified herein, weatherization service providers shall be responsible for identifying and addressing the need for additional intermittent or spot ventilation devices.

Weatherization service providers shall ensure that dwelling owners and occupants are educated on the rationale and requirement to provide adequate mechanical exhaust ventilation dwellings at the outset of the job, as well as proper operation and maintenance of all devices present. Documentation of actions taken to comply with this standard, including specification data for each fan installed, shall be maintained in the job file.

6000 Diagnostic Testing Procedures

Dwelling-specific diagnostic testing shall be conducted on every dwelling weatherized, both at the time of initial audit and as mandated thereafter.

Weatherization service providers shall ensure that weatherization field personnel including, but not limited to, auditors, weatherization installers, inspectors, and subcontractors possess appropriate equipment and training to properly perform all required diagnostic testing.

Initial, interim, and final diagnostic tests shall be conducted at specified times during the weatherization process. Documentation of test types performed, test readings, and the identity of the individuals performing tests shall be maintained in the job file.

Diagnostic test types and guidelines listed herein shall not be considered exhaustive. Diagnostic procedures not listed herein shall be performed where required to maximize the potential benefits of energy efficiency measures installed or to maintain the health and safety of the dwelling and its occupants.

6100 Pre-Diagnostic Inspections

Prior to conducting diagnostic testing a full dwelling inspection shall be completed to identify and document pre-test dwelling conditions, including potential health and safety hazards. Appropriate diagnostic tests and testing methods shall then be determined and conducted based on the specific conditions observed within the dwelling.

Potentially hazardous dwelling conditions requiring special consideration and caution prior to conducting diagnostic testing include, but shall not be limited to, the presence of:

- A) Building materials suspected to contain friable asbestos, including vermiculite-based attic insulation
- B) Mold, excessive moisture issues, or biological hazards, including raw sewage
- C) Dwelling occupants with preexisting health conditions which testing may exacerbate.

Diagnostic testing shall cease or be postponed wherever dwelling conditions that may pose an immediate safety hazard are identified or where conditions observed necessitate that the dwelling be placed on deferral status.

6200 Blower Door Diagnostics

Blower door diagnostics shall be performed using a blower door fan to create a pressure difference between two spaces for the purposes of diagnosing air leakage or connectivity between the spaces.

6210 Blower Door Guided Air Sealing

The blower door (used in concert with a digital manometer or pressure and flow gauge) is a building performance diagnostic tool used for the purpose of identifying air leakage or infiltration. Blower-door-guided air sealing and related blower door diagnostics shall be performed using either the pressurization or the depressurization test set-up.

Blower-door-induced depressurization has the ability to draw contaminants into the living space; therefore, it is vital that a complete inspection of the dwelling be performed prior to conducting blower door testing. Identification of specific dwelling conditions may necessitate use of pressurization testing versus depressurization testing to avoid exposing the dwelling and occupants to potential adverse effects resulting from blower door testing including, but not limited to, conditions listed in section 6100 of this Chapter.

Blower door testing shall be performed based on a sustained 50 Pascal (Pa) pressure difference in the dwelling with reference to (WRT) the outdoors, measured using a digital manometer. Airflow readings measured in CFM shall be adjusted as needed where a 50 Pa. pressure difference cannot be established by using either the “Can’t Reach Fifty” multiplier or use a manometer that makes this conversion automatically.

Testing procedures for pressurization testing require some alterations to the test set up in addition to reversing the direction of the airflow per manufacturer instructions for the particular device model in use. Exhaust vent dampers (bathroom, kitchen, and dryer) must be temporarily blocked to insure accurate readings.

6220 Zonal Pressure Diagnostics

Zonal Pressure Diagnostics (ZPD) shall be performed at intersections between the intentionally conditioned main body of a dwelling and areas where unintentional connections with unconditioned spaces most often occur including, but not limited to, areas such as:

- A) Garages;
- B) Basements;
- C) Additions;
- D) Dropped soffits;
- E) Bath or shower enclosures;
- F) Upper or lower floor levels.

Test holes or penetrations drilled into the dwelling shell to perform ZPD shall be located in inconspicuous areas such as closets, utility rooms, or other areas where holes are least likely to be visible post-work. Alternatively, existing holes may be used for ZPD, include crawl space hatches vents, and basement doors. Penetrations made in ceilings or floors shall be located as close to the perimeter of the dwelling as possible. For final testing, holes shall be patched with a caulking material similar in color to the drilled or cut surface. Use of similarly colored plastic plugs or “buttons” for repairing test penetrations shall also be allowed.

6230 Duct-Tightness Testing

Duct-tightness testing shall be conducted in every weatherized dwelling where a ducted distribution system is present. Distribution systems shall be visually inspected, including operation of the associated air handler to identify leakage in the system, in addition to conducting duct-tightness testing using the blower door and pressure pan/duct mask method. Pressure readings shall be recorded for all supply and return registers.

In dwellings in which the Priority List shall be used, accessible portions of active duct distribution systems shall be sealed to a tightness of 1.0 Pa or below, as measured with a pressure pan and the blower door depressurizing the dwelling to 50 Pa and ducts measured WRT the dwelling. When conducting duct tightness testing, if the duct

location is less than 45 Pa, a pressure pan multiplier shall be used to compensate for the difference in testing conditions. Where compliant test pressures of 1.0 Pa are not achieved, justification for the failure shall be documented in the job file.

Abandoned duct distribution systems shall be closed off from the dwelling and sealed to restrict airflow between conditioned and unconditioned space with the goal of limiting pressure variations between the two spaces to as close to zero (0.0 Pa) as possible.

In dwellings in which the NEAT portion of the WA shall be used, duct leakage to the outside shall be no more than 8 CFM per 100 sq. ft. of conditioned floor area. This is measured with a duct blower depressurizing the duct system to 25 Pa WRT the outdoors and a blower door simultaneously depressurizing the dwelling to 25 Pa WRT the outdoors. Total duct leakage shall be no more 12 CFM per 100 sq. ft. of conditioned floor area. This is measured with a duct blower depressurizing the duct system to 25 Pa WRT the outside. Where compliant test pressures of 8 CFM and 12 CFM per 100 sq. ft., respectively, of conditioned floor area are not achieved, justification for the failure shall be documented in the job file.

6300 Duct Induced Room Pressure Testing

Room-to-room duct-induced pressure testing shall be conducted in every weatherized dwelling where an active ducted distribution system is present. Room-to-room pressure readings shall not deviate more than plus or minus 3.0 Pa WRT the outdoors. Where induced pressure readings exceed 3.0 Pa WRT outdoors, one or more of the following corrective measures shall be required:

- A) Undercutting doors
- B) Adding pass-through vents above doors
- C) Adding jump-over ducts between rooms
- D) Adding return air to the room (performed only by licensed HVAC technicians on a limited case-by-case basis).

Only option is A) is allowable option with providing pressure relief for bathrooms. Where dwelling owners fail to authorize installation of standard corrective measures for providing room pressure relief, written documentation of the measures proposed and the signature of the dwelling owner declining the measures shall maintained in the job file.

6.6201.2a	Balancing pressure	An appropriate means of pressure balancing will be installed (e.g., transfer grilles, jumper ducts, individual room returns) No room will exceed +/- 3 pascals with reference to the outdoors with all interior doors closed and ventilation systems running	Ensure free flow of air between rooms Preserve integrity of the building envelope
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6400 Exhaust Fan Flow Meter Diagnostics

All functioning exhaust fans located in weatherized dwellings shall be metered during the initial audit and final inspection using an approved fan-exhaust metering device. Existing re-circulating fans may either be corrected to exhaust to the outdoors or shall be replaced as part of the weatherization process and therefore need not be metered at the time of audit.

Where existing exhaust fans are determined to be providing less than the required minimum CFM, the following corrective measures shall be performed:

- A) Fan shall be checked to ensure it is installed per manufacture specifications and corrected where installed incorrectly
- B) Fan shall be cleaned to ensure it is free of debris or obstructions
- C) Fan exhaust venting shall be repaired or replaced to achieve the shortest and straightest run possible.

During the final inspection all fans present shall be re-metered and the need for intermittent ventilation, if any, shall be determined. Where the need for ventilation exists, a timer shall be set as needed to provide the required CFM of additional airflow based on specifications provided in section 5800.

6500 Combustion Analysis

Combustion analysis shall be performed in every weatherized dwelling where fuel-fired or combustion appliances are present. Where a compliant, nonfunctioning, fuel-fired unit exists and will remain in the dwelling post-weatherization, combustion analysis shall be performed as soon as the unit is made functional. Applicable combustion analysis inspection and diagnostic requirements shall include *at minimum* the following procedures where applicable:

- A) Fuel Supply Inspection—the fuel supply for all liquid or gas-fired appliances shall be tested for leaks and addressed as needed prior to additional system testing.
- B) Combustion Vent Pipe—combustion venting systems shall be inspected to ensure systems are suitable for the heating unit type and location where installed. Venting shall be properly sized, material types shall be appropriate, vent pipe condition shall be satisfactory, clearances shall meet applicable codes, and the vent system shall be unobstructed.

2.0201.1c	Venting	Combustion venting systems will be inspected for damage, leaks, disconnections, inadequate slope, and other safety hazards	Determine if a regulator is present and working and if vent system is in good condition and installed properly
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- C) Combustion Air Supply—adequate combustion air supply shall be provided for all combustion appliances located in weatherized dwellings as mandated by the Installation Standards and National Fire Protection Association (NFPA) code. Combustion supply air shall be considered adequate when the volume of the space used for combustion air is at least 50 cubic feet per 1000 Btu's of the appliance(s) rated input. Where additional combustion air is required, the following minimum combustion air supply limitations shall apply:
 - a. Where all combustion air is obtained from the house, 1 sq. in. of net free area per 1,000 Btu of input shall be allowed.
 - b. Where all combustion air is obtained from the outdoors via a vertical pipe, 1 sq. in. of net free area per 4,000 Btu of input shall be allowed.
 - c. Where all combustion air is obtained from the outdoors via a horizontal pipe, 1 sq. in. of net free area per 2,000 Btu of input shall be allowed.

Combustion air shall be provided using a high/low orientation where one source is located 12 in. from the floor and another source is located 12 in. from the ceiling. Obtaining *additional* combustion air from both the living space and from the outdoors shall be prohibited.

Combustion Appliance Zone (CAZ) testing shall be performed on all functioning, fuel-fired vented appliance systems located in the living space and conditioned attics and basements but excluding unconditioned attics,

crawl spaces, garages, and basements of weatherized dwelling during the initial audit, the final inspection, and as needed throughout the weatherization process. Worst-case CAZ depressurization limits are shown below:

CAZ Depressurization Limits	
Venting Conditions	Limits (Pascals)
Orphan natural draft water heater (including outside chimneys)	-2
Natural draft boiler or furnace commonly vented with water heater	-3
Natural draft boiler or furnace with vent damper commonly vented with water heater	-5
Individual natural draft boiler or furnace	-5
Mechanically assisted draft boiler or furnace commonly vented with water heater	-15
Mechanically assisted draft boiler or furnace alone, or fan assisted DHW alone	-15
Exhaust chimney-top draft inducer (fan at chimney top); High static pressure flame retention head oil burner; Sealed combustion appliances	-50

Exception: Wood burning and lump coal units where no fuel is available during the cooling season shall be visually inspected to determine the condition of the following components - cracks in the heat exchanger, corrosion, improper venting, and clearance from combustibles.

Combustion Appliance Zone (CAZ) Testing			
2.0201.1d	Base pressure test	Baseline pressure will be measured in Combustion Appliance Zone with reference to outdoors	Measure pressure difference between combustion zone and the outside under natural conditions
2.0201.1e	Depressurization test	Depressurization test will include exhaust fans, interior door closure, or duct leakage, or a combination thereof, and will not be more negative than -3 pascals accounting for base pressure	Measure combined effect of mechanical system fans on combustion zone
2.0201.1f	Spillage test	If a combustion appliance spillage exceeds one minute during pressure testing, specify measures to mitigate	Detect excessive spillage of combustion gasses
2.0201.1g	Carbon monoxide (CO) test in appliance vent	CO will be tested for in undiluted flue gases of combustion appliances If CO levels exceed 200 ppm as measured, or 400 ppm air-free measurement, service will be provided to reduce CO to below these levels (unless CO measurement is within manufacturer specifications) If the outlet of the exhaust is accessible, include a CO test on all sealed-combustion, direct vent, and power-vented appliances (without atmospheric chimneys)	Measure CO and report excessive levels
2.0201.1i	Combustion safety testing at completion of retrofitting home	Upon completion of work, all homes receiving retrofits will receive combustion safety testing	Ensure work completed in home has not adversely affected the operation of combustion appliances

Combustion Air for Natural Draft Appliances			
2.0203.1a	Required combustion air	The required volume of indoor air will be determined in accordance with Section G2407.5.1 or G2407.5.2 and authority having jurisdiction, except that where the air infiltration rate is known to be less than 0.40 air changes per hour (ACH), Section G2407.5.2 will be used	Determine if existing conditions meet the combustion air calculation

2.0203.1b	Additional combustion air (if action is required)	Additional combustion air will be provided in accordance with 2012 IRC G2407 and authority having jurisdiction	Ensure adequate combustion air for operation of the appliance
2.0203.3a	Assessment	The presence of an operable draft regulator will be verified Combustion venting systems will be inspected for damage, leaks, disconnections, and other safety hazards	Determine if a regulator is present and working and if vent system is in good condition and installed properly
2.0203.3b	Installation (if action is required)	A draft regulator will be installed, if necessary Manufacturer specifications for installation will be followed (e.g., size, type, location)	Install regulator in accordance with manufacturer specifications
2.0203.3c	Retesting spillage	If a combustion appliance spillage exceeds one minute during pressure testing, specify measures to mitigate	Ensure appliance is not spilling longer than one minute
2.0203.3d	Occupant health and safety	All homes will have a functioning CO alarm If CO levels in interior living spaces exceed outdoor levels, potential sources will be investigated and appropriate action taken to reduce them (e.g., have a qualified professional tune, repair, or replace improperly operating combustion appliances; apply weather stripping or conduct air sealing between the garage or crawl space and the home)	Ensure occupant health and safety Ensure indoor CO levels do not exceed outdoor CO levels
2.0203.3e	Occupant education	Occupants will be educated on the operation and maintenance of the CO alarm Completed work on combustion appliances and recommended maintenance will be reviewed with occupant Occupant will be provided information regarding the health effects and risk of high CO concentrations; EPA provides possible expanded actions and offers client education information in an appendix to the protocols	2.0203.3e
2.0299.1a	Atmospheric water heater only (Category I, natural draft), open-combustion appliances	Manufacturer's certified negative pressure tolerance rating: • Limit -2 pascals	Ensure appliances meet manufacturer's certified negative pressure tolerance rating
2.0299.1b	Atmospheric water heater (Category I, natural draft) and atmospheric furnace (Category I, natural draft), common-vented, open-combustion appliances	Manufacturer's certified negative pressure tolerance rating: • Limit -3 pascals	Ensure appliances meet manufacturer's certified negative pressure tolerance rating
2.0299.1c	Gas furnace or boiler, Category I or Category I fan-assisted, open-combustion appliances	Manufacturer's certified negative pressure tolerance rating: • Limit -5 pascals	Ensure appliances meet manufacturer's certified negative pressure tolerance rating
2.0299.1d	Oil or gas unit with power burner, low- or high-static pressure burner, open combustion appliances	Manufacturer's certified negative pressure tolerance rating: • Limit -5 pascals	Ensure appliances meet manufacturer's certified negative pressure tolerance rating
2.0299.1f	Induced-draft appliances (fan at point of exit at wall), Category I with induced draft, open-combustion appliances	Manufacturer's certified negative pressure tolerance rating: • Limit -15 pascals	Ensure appliances meet manufacturer's certified negative pressure tolerance rating
2.0299.1g	Pellet stoves with exhaust fan and sealed vent	Manufacturer's certified negative pressure tolerance rating: • Limit -15 pascals	Ensure appliances meet manufacturer's certified negative pressure tolerance rating
2.0299.1h	Gas appliances, Category III vented through the wall, forced draft, open-combustion appliances	Manufacturer's certified negative pressure tolerance rating: • Limit -15 pascals	Ensure appliances meet manufacturer's certified negative pressure tolerance rating
2.0299.1i	Direct-vent, sealed combustion appliances with forced draft	Manufacturer's certified negative pressure tolerance rating: • Limit -50 pascals	Ensure appliances meet manufacturer's certified negative pressure tolerance rating

D) **Steady State Efficiency (SSE)**—SSE testing shall be performed on all vented combustion heating systems to determine whether systems are functioning at or near the rated or peak efficiency for the particular unit type. SSE is tested in conjunction with CO or draft tests and is measured automatically using a combustion analyzer.

SSE readings recorded shall reflect the efficiency percentage for the unit under ideal conditions, or as measured once the system has been operating long enough to reach steady state. Steady state has typically been reached when stack temperatures increase by not more than 2 degrees Fahrenheit (°F) in 60 seconds. SSE test readings coupled with CO, Oxygen, and stack temperature readings may provide clues as to the cleaning or tuning needs for a heating unit.

HEATING UNIT/SYSTEM TYPE	COMMON STEADY STATE EFFICIENCY RANGES BY SYSTEM TYPE (%)*
High-Efficiency Condensing	85 - 95 %
Powered Boiler	75 - 85 %
Oil Burner System	70 - 85 %
Low-Efficiency Atmospheric	70 - 80 %
Vented Space Heater	50 - 80 %
*Rates shall be used for reference purposes only and shall not define "pass" or "fail" for any unit type.	

- E) Carbon Monoxide Testing— ambient CO levels shall be monitored upon entering dwellings and throughout the testing period for all appliances to ensure safe CO levels are not exceeded. Ambient CO levels of 35 parts per million (ppm) or greater shall require immediate action to identify and correct the problem prior to resuming system testing. The maximum allowable post-work ambient CO levels in weatherized dwellings shall be 35 ppm.
- F) CO levels in undiluted flue gases shall be tested on all vented combustion appliances. Where CO levels in undiluted flue gasses are measured at 100 ppm or greater, immediate action shall be taken to identify and correct the deficiency prior to resuming testing.

CO levels shall be tested in association with all unvented combustion space heaters. Tests shall be conducted by holding the test probe at or near the unit while firing and shall be measured based on the 35 ppm maximum for ambient CO levels.

- G) Draft Testing—a worst-case draft test shall be conducted on all liquid or gas-fired appliances to ensure allowable draft pressures for the venting system can be sustained under worst-case conditions, enabling combustion gases to be safely exhausted from the dwelling.

Draft testing shall be performed on all functioning, fuel-fired vented appliance systems located in the shell (including attics, crawl spaces, and basements) of weatherized dwelling during the initial audit, the final inspection, and as needed throughout the weatherization process. When testing, there should be no spillage after 1 minute at worse case conditions and acceptable draft should establish after 5 minutes. If appropriate draft (see Residential Energy Audit Tool Instructions for more information) is not established corrective action must be taken.

Outside Temperature (Degree F)	Minimum Draft Pressure Standard (Pa)
<10	-2.5
10-90	(T _{out} ÷ 40) -2.75
>90	-0.5

6510 Draft and Combustion Testing by System Type

- A) Sealed Combustion or Power Vented (90% +)—No draft measurement shall be required and no holes shall be drilled in flues for power vented or sealed combustion units. CO levels shall be measured at the exterior outlet of the flue where accessible. Where it is deemed unsafe to access termination points for testing due to the height of the roof, testing requirements shall be waived; but such situations shall be documented in the job file.
- B) Atmospheric or Natural Draft (70%)—Draft testing shall be conducted in the center of the longest straightest accessible section of the vent. Holes drilled in order to measure draft shall be drilled using a 5/16th drill bit. Post-testing, holes shall be plugged using a 3/8 in. stainless steel tap bolt and sealed with high-temperature 100% room temperature vulcanizing (RTV) silicone caulk. To ensure a tight seal, plug bolts shall be coated with high-temperature silicone prior to being placed. CO testing shall be conducted at the heat exchanger cell outlets in undiluted flue gases.
- C) Induced Draft (80%)—Draft testing shall be conducted in the center of the longest straightest accessible section of the vent. Holes drilled to measure draft and CO (single location for both tests) shall be drilled using a 5/16th drill bit. Post-testing, holes shall be plugged and sealed in the same manner as holes on atmospheric or natural draft devices.
- D) Water Heaters and Orphaned Water Heaters - Draft testing shall be conducted in the center of the longest straightest accessible section of the vent after the draft hood. Holes drilled in order to measure draft shall be drilled using a 5/16th drill bit. Post-testing, holes shall be plugged using a 3/8 in. stainless steel tap bolt and sealed with high-temperature 100% room temperature vulcanizing (RTV) silicone caulk. To ensure a tight seal, plug bolts shall be coated with high-temperature silicone prior to being placed. CO testing shall be conducted before the draft hood in undiluted flue gases.

2.0203.2a	Spillage testing	If a combustion appliance spillage exceeds one minute during pressure testing, specify measures to mitigate	Ensure appliance is not spilling longer than one minute
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2.0203.2b	Flue gas removal (chimney liner or approved methods)	A chimney liner will be installed in accordance with the 2012 IRC or applicable NFPA standard	Allow water heater to vent properly Prevent damage to the chimney
2.0203.2c	Retesting spillage	If a combustion appliance spillage exceeds one minute during pressure testing, specify measures to mitigate	Ensure appliance is not spilling longer than one minute
2.0203.2d	Required combustion air	The minimum required volume will be 50 cubic feet per 1,000 Btu/h in accordance with 2012 IRC G2407.5.1 and authority having jurisdiction	Determine if existing conditions meet the combustion air calculation
2.0203.2e	Additional combustion air (if action is required)	Additional combustion air will be provided in accordance with 2012 IRC G2407 or other authority having jurisdiction	Ensure adequate combustion air for operation of the appliance
2.0203.2f	Occupant health and safety	All homes will have a functioning CO alarm If CO levels in interior living spaces exceed outdoor levels, investigate potential sources and take appropriate action to reduce them (e.g., have a qualified professional tune, repair or replace improperly operating combustion appliances; apply weather stripping or conduct air sealing between the garage or crawl space and the home)	Ensure occupant health and safety Ensure indoor CO levels do not exceed outdoor CO levels
2.0203.2g	Occupant education	Occupants will be educated on the operation and maintenance of the CO alarm Completed work on combustion appliances and recommended maintenance will be reviewed with occupant Occupant will be provided information regarding the health effects and risk of high CO concentrations; EPA describes possible expanded actions, and offers client education information in an appendix to the protocols	Ensure occupant can operate and maintain installations Inform occupant regarding possible CO hazards

- E) Oil Furnace (75-80+%) - Draft testing shall be conducted in the center of the longest straightest accessible section of the vent, but before the barometric damper. SSE shall be measured and Oil furnaces with SSE less than 75% shall be evaluated for a flame retention head oil burner (FRHOB). FRHOB have motors that run faster (3450 rpm) than older oil burners (1725 rpm). When replacing an older burner with a FRHOB, ensure the burner orifice is evaluated for resizing. Type- L vent, which is stainless-steel inner pipe and galvanized-steel outer pipe, shall be used with oil furnaces.

5.3003.2a	Oil system: nozzle size	Nozzle size will be correct for design input and within equipment firing rate of the heating system manufacturer	Ensure equipment operates as designed Ensure equipment operates safely Ensure equipment operates efficiently Ensure equipment is durable
5.3003.2b	Fuel pressure	Measurement will be verified in accordance with manufacturer specifications	Ensure equipment operates as designed Ensure equipment operates safely Ensure equipment operates efficiently Ensure equipment is durable
5.3003.2c	Oil system: steady state efficiency (SSE)	Measurement will be verified in accordance with manufacturer specifications	Ensure equipment operates as designed Ensure equipment operates safely Ensure equipment operates efficiently Ensure equipment is durable
5.3003.2d	Oil system: smoke test (This test must be conducted before any combustion testing is completed)	Smoke spot reading will be in accordance with burner manufacturer specifications If smoke test is more than actionable levels, specify a clean and tune	Ensure equipment operates as designed Ensure equipment operates safely Ensure equipment operates efficiently Ensure equipment is durable
5.3003.2e	Net stack temperature	Net stack temperature will be measured and verified in accordance with manufacturer specifications	Ensure equipment operates as designed Ensure equipment operates safely Ensure equipment operates efficiently Ensure equipment is durable
5.3003.2f	Carbon dioxide and oxygen	Measurement will be verified in accordance with industry manuals and manufacturer specifications	Ensure equipment operates as designed Ensure equipment operates safely Ensure equipment operates efficiently Ensure equipment is durable

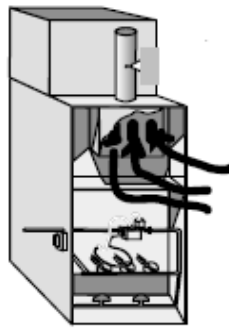
5.3003.2g	Excess air	Excess air will be calculated and shown to be in accordance with manufacturer specifications	Ensure equipment operates as designed Ensure equipment operates safely Ensure equipment operates efficiently Ensure equipment is durable
5.3003.2h	CO in flue gas	Undiluted flue gases will be checked with a calibrated combustion analyzer For CO levels exceeding 100 ppm as measured, or 400 ppm air-free measurement, service will be provided to reduce CO to below these levels (unless CO measurement is within manufacturer specifications)	Ensure equipment operates as designed Ensure equipment operates safely Ensure equipment operates efficiently Ensure equipment is durable

Care shall be taken by weatherization personnel to ensure that holes drilled for testing purposes are consistently as close to 5/16 in. in diameter as possible both for purposes of repeat testing and ease of plugging such holes using standard 3/8 in. stainless steel or nylon tap bolts. Care shall additionally be taken to ensure that holes are well plugged and sealed, particularly holes drilled through the inner liner of B- vent piping both for reasons of manufacturer warranty and local code compliance.

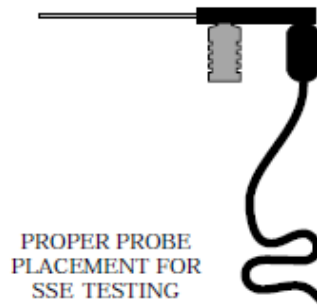
The American Gas Association Venting Categories		
	Negative Pressure Venting	Positive Pressure Venting
Non-condensing	I Combustion Efficiency 83% or less Flue Gas over 140°F Use standing venting: Masonry or Type B Vent	III Combustion Efficiency 83% or less Flue Gas over 140°F Use only pressured vent as specified by the manufacturer
Condensing	II Combustion Efficiency Over 83% Flue Gas under 140°F Use only condensing service vent as specified by manufacturer	IV Combustion Efficiency Over 83% Flue Gas under 140°F Use only pressurizable condensing service vent as specified by manufacturer

A diagram depicting common heating unit types and testing locations may be referenced at the end of this chapter.

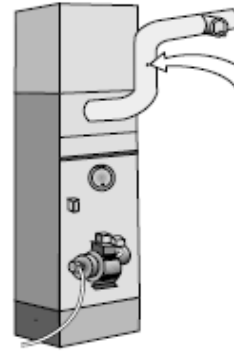
Common Heating Systems and Combustion Testing Locations



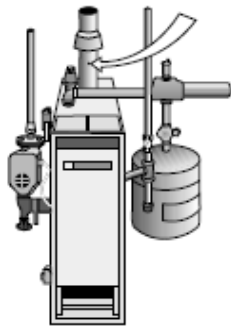
Atmospheric Furnace



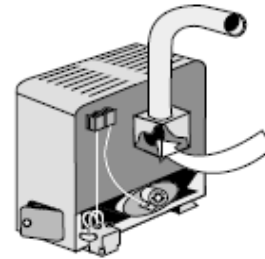
PROPER PROBE
PLACEMENT FOR
SSE TESTING



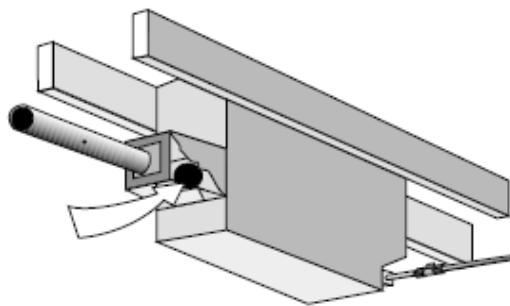
Fuel Oil Furnace



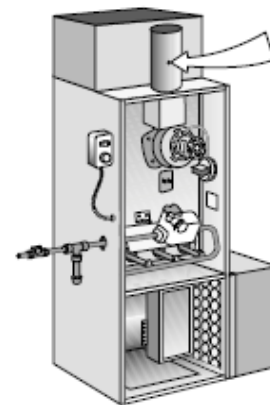
Atmospheric Boiler



Space Heater



Floor Furnace



80+ Induced-draft Furnace

6520 Fuel-Fired Cooking Appliance Testing and Repair

Fuel-fired cooking appliances, specifically range-top and oven burners, shall be tested to ensure appliances are not emitting unsafe levels of CO. Where unacceptable CO levels are detected, servicing or repairing appliances shall be required. Under no circumstances shall cooking appliance replacement be allowed.

Maximum allowable CO levels for fuel-fired range-top and oven burners:

- A) Range-top burners - 25 ppm as measured
- B) Oven burners - 100 ppm as measured or 400 ppm air-free.

Each range-top burner assembly shall be tested separately by firing the burner and reading the associated CO level after four minutes of continuous operation. Measurements shall be taken with the test probe located approximately 6 in. above each operating burner.

Where initial test readings are 25 ppm or greater as-measured, corrective actions shall include but not be limited to:

- A) Inspecting burners for obstructed ports
- B) Servicing of the appliance by a repair professional trained and certified to service the *brand* of appliance in use
- C) Retesting the burner CO levels post-cleaning
- D) Educating occupants on burner cleaning and maintenance procedures where applicable.

2.0201.2e	Gas range burners	Specify clean and tune if the flame has any discoloration, flame impingement, or an irregular pattern or if burners are visibly dirty, corroded, or bent	Ensure clean burn and operation of gas range burners
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Fuel fired oven burner assemblies shall be tested. Testers shall ensure that all cooking utensils, protective pans, or aluminum foil are removed from the oven. Primary oven burners shall be fired on the highest baking-mode temperature setting. Broil-mode temperature settings *shall not* be used during oven testing; where present, separate broiler burner assemblies shall be excluded from testing.

After approximately ten minutes of operating time, test probes shall be inserted into oven exhaust vents at a depth that enables testing of the undiluted exhaust gases. CO levels customarily peak just after burner firing and then fall to a momentary plateau prior to the burners shutting down as part of the duty cycle. CO readings recorded shall be taken during this stable plateau.

Where initial test readings are 100 ppm or greater as-measured or 400 ppm air-free, corrective actions shall include but not be limited to:

- A) Identifying and removing obstructions in the air supply
- B) Servicing of the appliance by a repair professional trained for appliance in use
- C) Confirming burner is in alignment and leveling the entire appliance where applicable
- D) Educating occupants on how to clean the flame plate where applicable.

Where servicing or repair work is necessary and is determined to be unfeasible or cost-prohibitive, the dwelling shall be placed on deferral status until the hazard condition can be corrected.

2.0201.2d	Gas ovens	Gas ovens will be tested for CO A clean and tune will be conducted if CO in the flue gas in the oven vent exceeds 100 ppm as measured, or 400 ppm air-free measurement, at steady state	Ensure clean burn of gas ovens
2.0201.2f	Solid fuel burning appliances	Replacement of solid fuel burning appliance with UL-listed and EPA-certified appliances if the existing appliance is not UL-listed or has signs of structural failure	Ensure safe operations of solid fuel burning appliances

6530 Fuel-Fired Clothes Dryer Testing and Repair

Fuel-fired clothes dryers shall be inspected for proper operation including, but not limited to, gas leak testing and testing ambient CO levels in the room in which the dryer is located and at the exhaust hood located outside of the dwelling.

Where unacceptable CO levels are detected, servicing or repairing appliances shall be allowed. Where servicing or repair work is necessary and is determined to be unfeasible or cost-prohibitive, the dwelling shall be placed on deferral status until the hazard condition can be corrected. Under no circumstances shall clothes dryer replacement be allowed.

7000 Heating, Ventilating, and Cooling Systems

Improperly functioning HVAC systems often contribute to adverse conditions in low-income dwellings including, but not limited to, moisture and mold growth, CO poisoning, fire hazards, and increased heating and cooling expenses. Each of these serious potential conditions may be exacerbated by weatherization work where steps in the weatherization process are skipped or poorly performed, putting both the dwelling and the dwelling occupants at risk. Guidance issued in this section shall apply to HARRP.

7100 ACCA Standard 4

As substantial harm can result from failures to properly address heating, ventilating, and air conditioning (HVAC) systems in weatherized dwellings, NC WAP has adopted standards for inspecting, repairing, and replacing HVAC equipment that include employing the services of professional HVAC technicians licensed by the State of North Carolina.

In addition to compliance with the Installation Standards and applicable local codes, all HVAC-related services performed, whether by professional HVAC technicians or weatherization service providers, shall additionally comply with the ANSI/Air Conditioning Contractors of America (ACCA) Standard 4 - [Maintenance of Residential HVAC Systems -2007](#). Where conflicts exist between these Installation Standards, ANSI/ACCA Standard 4, and applicable local codes, the more stringent standard shall govern.

Under no circumstances shall the act of employing a licensed HVAC technician in any way diminish the responsibility of weatherization service providers as program administrators to ensure compliance with all applicable standards and guidance governing the identification, inspection, maintenance, repair, replacement, and safe operation of HVAC systems.

HVAC repairs, upgrades, or replacements performed in compliance with the standards listed herein shall be as energy-efficient for the client and as cost-effective for WAP as possible.

7200 Evaluate, Clean, and Tune Requirements

Every dwelling weatherized shall have all HVAC systems evaluated, cleaned, and tuned (ECT) by a licensed HVAC technician unless otherwise excepted herein. The ECT shall be performed only after completion of the dwelling audit. Required repairs or replacements shall be complete prior to any subsequent weatherization work commencing. An ECT shall consist at a minimum of inspection, safety & efficiency testing, cleaning, and adjustment of all system components, fuel supply, piping, venting components, chimneys, flues, and all heating units present in the dwelling. ECT requirements shall extend to central air conditioning systems where applicable.

HVAC technicians performing ECTs shall hold at minimum a current Heating, Group 3, Class I or Class II license issued by the State of North Carolina. Possession of a Heating Group 1, Class I or Class II license is required for work on boilers or other steam systems. Weatherization service providers shall be responsible for ensuring that all HVAC technicians performing services are properly licensed, insured, and bonded (where applicable). HVAC contractor license status may be verified online by accessing the State Board of Examiners webpage located at: <http://www.nclicensing.org/OnlineReg.htm>.

Where dwellings rely on fuel-fired or combustion heating units (particularly wood burning stoves, fireplaces, and oil furnaces), evaluation of the venting components and associated chimneys or flues is

critically important. In such instances the services of a chimney professional certified by the National Fireplace Institute (NFI) or Chimney Sweep Safety Institute of America (CFIA) may additionally be retained where the HVAC technician responsible for performing the ECT either lacks adequate knowledge of servicing fuel-fired venting components and chimneys, or where the ECT identifies deficiencies a chimney professional might be better trained and equipped to rectify. NFI certified Wood Burning and Pellet Burning Specialists may be located by accessing the NFI webpage at: <http://nficertified.org/index.html>. CFIA certified chimney sweeps may be located by accessing the CFIA webpage at: <http://www.csia.org/>.

HVAC technicians (and chimney sweeping professionals where applicable) shall complete the Heating, Ventilation, and Air Conditioning System Evaluation Report for every weatherized dwelling. Reports must fully document conditions observed during the evaluation including, but not limited to, diagnostic testing results, conditions observed through visual inspection, and suggested corrective actions for any deficiencies identified. A copy of the ECT Report and any supplemental data provided shall be maintained in the job file.

Exception: Evaluation by a licensed HVAC technician shall not be required where a dwelling relies solely on permanently installed electric space heaters (for example, hard-wired electric baseboard heaters) as the primary heat source and no fuel-fired supplemental heat sources are present. Supplemental heating systems (defined below) shall not be required to have an evaluation by a licensed HVAC technician. Evaluation and cleaning shall still be performed on such units, though the services may instead be performed by a qualified member of weatherization service provider staff in compliance with applicable standards listed herein.

Weatherization service providers shall be ultimately responsible for ensuring the compliance of all HVAC systems present in weatherized dwellings and shall therefore be required to provide detailed specifications, maintain detailed documentation, and thoroughly inspect all work performed by licensed HVAC technicians and related third-party professionals prior to accepting such services as complete.

7300 Mandatory Heat Provision Requirement

A PROPERLY FUNCTIONING, ADEQUATE, AND SAFE PRIMARY HEAT SOURCE SHALL BE PRESENT IN EVERY ELIGIBLE DWELLING PRIOR TO ANY WEATHERIZATION PROGRAM SERVICES (EXCEPTING THE INITIAL AUDIT AND THE ECT) BEING PROVIDED.

A properly functioning heat source is one that is functioning as intended by the manufacturer and is free from material defects in installation, maintenance, and operation. A properly functioning heating source should perform at or near the maximum rated efficiency for that unit. An adequate heat source is one that provides heat sufficient to warm the intentionally conditioned spaces within the dwelling to not less than 68°F at an outside temperature of 20°F. A safe heat source is one that when used as intended poses no risk of adverse effects to the dwelling or to the client.

7310 Definition of Primary Heat Source

Primary Heat Source – As all parts of the state experience at least 3400 heating degree hours per year, a primary heat source shall be required. The primary heat source shall be defined as one or more safe, permanently installed, properly functioning, central or space heating units and their associated fuel sources which together are capable of heating all intentionally conditioned spaces within the dwelling to not less than 68°F, where the outside temperature is 20°F or greater.

Where a weatherization-eligible dwelling initially lacks a system or systems which together comprise a compliant primary heat source as defined herein, weatherization service providers shall take necessary actions to establish a compliant primary heat source for the dwelling, using existing fuel sources, prior to any subsequent weatherization work commencing.

At the time of the initial audit, weatherization service providers shall document the type and condition of all heating and cooling systems present in the dwelling pre-weatherization. When the weatherization job is complete, the type and condition of all heating and cooling systems shall again be documented, recording data for systems at current post-weatherization status. For federal reporting purposes (such as AR4CA) where only a single primary fuel source may be recorded, the recorded primary fuel source shall be deemed the post-weatherization source that generates the greatest percentage of heat for the dwelling, (i.e. the fuel source that generates 51% or more of the total heat where two contributing systems fueled by different fuel sources are present).

Allowable unit types that may contribute to the mandatory provision of a compliant primary heat source shall include:

- A) Electric
 - a) central heat pumps
 - b) window heat pumps
 - c) ductless (mini-split) heat pumps
 - d) packaged terminal air conditioners (PTAC) and packaged terminal heat pumps (PTHP)
 - e) central electric resistance furnaces (repairs only, replacements not allowed)
 - f) existing hard-wired space heaters, including wall, ceiling, and baseboard units (repairs only, replacements not allowed)
- A) Fuel-Fired
 - a) central package systems
 - b) central split systems
 - c) vented or sealed combustion space heaters
 - d) vented atmospheric space heaters
 - e) vented solid-fuel burning stoves (wood, pellet, coal)
 - f) steam, hot water, or boiler units (prior approval required)
 - g) gravity warm-air furnaces (repairs only, replacements not allowed)
 - h) vented fireplaces

Unvented fuel-fired space heaters, as well as portable heating units, regardless of fuel source, *shall never* constitute or contribute to a primary heat source.

Portable heating units are those designed for easy regular movement from room to room. Unit types listed as allowable contributors to a primary heat source may be considered moveable under certain conditions, but shall not be considered portable.

7320 Definition of Supplemental Heat Source

An audit, an ECT, and any work required to establish a primary heat source as defined herein shall be completed prior to any additional weatherization work being performed.

Supplemental Heat Source – The supplemental heat source shall be defined as one or more safe, properly functioning, portable or permanently installed space heating units and their associated fuel sources which provide additional heat to areas within the dwelling on a temporary or intermittent basis above and beyond the heat provided by the primary heat source.

UL Listed portable electric space heaters may remain in the dwelling during and post-weatherization where such units have been properly inspected and deemed to be operating safely.

A limited variety of unvented fuel-fired space heaters may remain in a dwelling during and after weatherization where such units have been properly inspected and deemed to be operating safely and where the unit complies with the minimum standards for unvented fuel-fired space heaters listed herein.

Where a compliant system serving as a supplemental heat source is evaluated and determined to be unsafe, the system may be repaired to the extent allowable or shall be surrendered by the owner and permanently removed from the dwelling and demanufactured prior to proceeding with weatherization.

7330 Unvented Fuel-Fired Space Heaters

Any unvented (also referred to as vent-less or vent-free) fuel-fired space heater remaining in a weatherized dwelling during or post-weatherization to serve as a compliant supplemental heat source shall:

- A) Not have an input rating in excess of 40,000 Btu/hr regardless of location (oxygen completion sensors are not required unless located in bathroom or bedroom);
- B) Not be located in or utility rooms, closets, or similarly restricted spaces.

Any single UL Listed, unvented, fuel-fired space heater remaining in a bathroom or a bedroom where allowed by local code shall:

- A) Not have an input rating in excess of 6,000 Btu/hr in a bathroom or 10,000 Btu/hr in a bedroom;
- B) Be equipped with an oxygen depletion sensing safety shut-off system;
- C) Have an adequate supply of combustion air based on the volume of the room where located;
- D) Be wall-mounted or permanently installed in a solid-fuel burning fireplace.

Any unvented fuel-fired space heater that does not comply with the standards listed herein shall be surrendered by the owner, permanently removed from the dwelling, and demanufactured prior to providing any subsequent weatherization program services.

Where unvented fuel-fired space heaters that do not comply with the standards listed herein exist in an otherwise weatherization-eligible dwelling, weatherization service providers shall be responsible for educating the client on the potential safety hazards associated with the operation of such units.

Weatherization service providers shall obtain voluntary, written surrender authorization from the property owner to remove and permanently de-manufacture all such units prior to providing any additional weatherization program services.

Owners who decline to authorize removal of noncompliant unvented fuel-fired space heaters shall be notified in writing that the dwelling must be placed in deferral status until the potential safety hazard represented by the noncompliant space heater has been removed.

Total program expenditures associated with dwellings where unvented fuel-fired space heating units are present may be disallowed where weatherization service providers fail to ensure either that:

- A) Noncompliant space heating units are properly identified
- B) Steps taken to address noncompliant space heating units are properly documented
- C) Written surrender authorization is obtained from the dwelling owner and the unit removed
- D) The dwelling is placed in deferral status until such time as the noncompliant space heating unit is surrendered.

Unvented Space Heaters: Propane, Natural Gas, and Kerosene Heaters			
2.0202.1a	Removal	<p>With the occupant's permission, unvented heaters will be removed except when used as a secondary heat source and when it can be confirmed that the unit is listed to ANSI Z21.11.2</p> <p>Units that are not being operated in compliance with ANSI Z21.11.2 should be removed before the retrofit but may remain until a replacement heating system is in place</p> <p>Failure to remove unvented space heaters serving as primary heat sources has the potential to create hazardous conditions and thus any further weatherization services will be re-evaluated in the context of potential indoor air quality risks</p>	Eliminate sources of combustion byproduct within a living space
2.0202.1b	Occupant education	Occupant will be educated on potential hazards of unvented combustion appliances (primary or secondary) within a living space	Inform occupant about possible hazards associated with combustion byproducts and moisture

7340 Mandatory Deferral Due to Lack of Primary Heat Source

Where evaluation of a system contributing to the primary heat source for a dwelling determines that the system must be repaired or replaced in compliance with the Installation Standards and insufficient program resources exist to complete the required work, no subsequent weatherization services shall be performed and the dwelling shall be placed on deferral status until such time as resources become available.

Failure by weatherization service providers to ensure that only compliant primary and supplemental heat sources are present in weatherized dwellings may result in all program expenditures associated with weatherizing the dwelling being disallowed.

7400 Initial and Final Weatherization Heating, Ventilating, and Air Conditioning System Evaluation

Under no circumstances shall the act of employing a licensed HVAC technician in any way diminish the responsibility of weatherization service providers as program administrators to ensure compliance with all applicable standards and guidance governing the identification, inspection, maintenance, repair, replacement, and safe operation of all HVAC systems.

In addition to compliance with ACCA Standard 4 and local codes, certain general evaluation requirements shall apply to HVAC assessments performed as part of initial audits and final inspections, for both the purposes of identifying potential hazards at the earliest opportunity as well as in order to assess the

dwelling conditions on which the work performed by HVAC technicians and other third-party subcontractors shall be predicated and judged.

Weatherization service providers shall be responsible for ensuring that all auditors and inspectors possess necessary training and equipment to enable them to accurately identify system type(s) and effectively perform type-specific preliminary evaluations as part of the initial audit/final inspection. Emphasis shall be placed on the ability of auditors to accurately identify and document heating system types existing pre-weatherization. Similar emphasis shall be placed on the ability of final inspectors to identify and document systems existing post-weatherization.

Weatherization personnel shall remain responsible for completing a variety of standard HVAC evaluation functions as mandated by initial audit and final inspection protocols or as necessitated by conditions present in a particular dwelling. Such inspection functions shall include, but shall not be limited to, identifying safety hazards that constitute emergency situations or that require repair work must be completed prior to proceeding with weatherization. Weatherization personnel shall at all times be responsible for documenting conditions observed and notifying dwelling occupants, as well as providing ongoing client education.

Weatherization HVAC system evaluation shall include, but not be limited to, functions outlined in Items 7410-7460 of this Section.

Evaluating Air Flow			
5.3003.3h	Temperature rise: gas and oil furnaces only	Temperature rise between the supply and return will be in accordance with manufacturer specifications	Ensure equipment operates as designed Ensure equipment operates efficiently Ensure equipment provides comfort Ensure equipment operates safely Ensure equipment is durable

7410 System Maintenance

Where a forced air distribution system is used, filter(s) shall be installed or replaced and a 4-month supply of appropriately sized filters for each filter location shall be provided to the client. Filters provided shall meet manufacturer specifications based on the type of system present and for new installation of central systems, must be at least MERV 6. Replacement of return grilles with filter grilles for greater client accessibility shall be allowed.

Evaluating Sequence of Operation			
5.3003.6a	Verification	The sequence of operation of the system will be verified in accordance with the manufacturer installation, operation, and maintenance manual	Ensure system components function and operate in the correct sequence

Heating and Cooling Controls			
5.3003.9b	Removal of existing controls	Existing controls will be removed in accordance with EPA lead-safe work rules	Protect workers and occupants from injury Protect environment from damage
5.3003.9c	Penetrations	Penetrations for control wiring will be sealed with a durable sealant (e.g., caulk, silicone, foam)	Ensure controls operate as designed Minimize infiltration and exfiltration from house
5.3003.9d	Thermostat location	Thermostats will be installed to reflect the temperature of the zone in which they are installed Thermostats will not be exposed to extreme temperatures, radiant heat sources, and drafts	Ensure controls operate as designed

Condensate Drainage of Heating and Air Conditioning Equipment			
5.3003.10a	Connection	Connections in condensate drain system will be watertight	Ensure condensate drain connections do not leak
5.3003.10b	Insulation	Condensate drainlines will be insulated with a minimum 1" of insulation with a vapor retarder when there is potential for condensation or freezing on the drainline	Ensure condensate drain connections do not leak
5.3003.10c	Overflow protection: upflow	Secondary drain pan and float switch will be installed when overflow could damage finished surfaces OR Float switch in the primary condensate drain for upflow systems will be installed when overflow could damage finished surfaces	Ensure condensate drain connections do not leak
5.3003.10d	Pumps	Condensate drain pumps will be installed when condensate cannot be drained by gravity Power source for pump will be installed Operation and drainage of pump will be verified	Ensure condensate drain connections do not leak
5.3003.10e	Vents and traps	Vents and traps will be installed on condensate drainlines Trap supplied with the equipment will be used and manufacturer specifications will be followed	Ensure condensate drain operates as designed Ensure condensate drain does not leak air
5.3003.10f	Drain pan	Condensate from all cooling coils or evaporators shall be conveyed from the drain pan outlet to an approved place of disposal Such piping shall maintain a minimum horizontal slope in the direction of discharge of not less than 1/8 unit vertical in 12 units horizontal (1% slope)	Prevent water damage from drain system malfunction
5.3003.10g	Float switch	All secondary drain pans will have a float switch and be drained away through a drainline	Prevent water overflowing the pan and draining onto the ceiling below
5.3003.10h	Termination	Condensate drain will be terminated in accordance with local codes	Ensure condensate does not leak to the house Ensure condensate drain does not freeze

Controls—Thermostat Replacement- Hydronic			
5.3104.1a	Visual inspection	Thermostats will be visually located Verify anticipator setting, if appropriate for thermostat model Replacement will be recommended if a digital, double setback thermostat is not present	Determine if existing thermostats need to be replaced
5.3104.1b	Mercury assessment	Thermostats containing mercury will be identified and disposed of in accordance with EPA guidance	Protect workers and occupants from mercury exposure
5.3104.1c	Removal (if removal is recommended)	Heating system will be de-energized before removal Thermostat will be removed Compatibility will be verified (e.g., voltage, wiring condition, location) and documented Location of existing thermostat will be assessed for appropriateness (e.g., central to the house, out of direct sunlight, away from supply air, protected from abnormal radiant surface temperatures)	Proper removal of thermostat
5.3104.1d	Installation	Location for new thermostat will be determined Compatibility with new thermostat will be verified (e.g., voltage, wiring, condition, location) Replacement will be recommended if a digital, double setback thermostat is not present Heating system will be re-energized and cycled Thermostat will be programmed to occupant lifestyle choices	Achieve comfort and energy savings for the occupant
5.3104.1e	Disposal	Thermostats will be disposed of in accordance with EPA guidelines and local regulations	Prevent mercury from entering the environment
5.3104.1f	Occupant education	Occupant will be involved in the initial programming of thermostat and educated on common settings and programming On new installs, occupants will be encouraged to save the manual and keep it accessible	Educate occupant on best use

Maintenance: Gas Boiler Service Inspection			
5.3104.2a	Visual inspection	The following conditions will be assessed by a licensed contractor: <ul style="list-style-type: none"> Water, steam, and fuel leaks Damaged or missing pipe insulation Venting issues—draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence) Corrosion (e.g., rust, mineral deposits) General condition of components 	Observe general conditions to determine needed repairs or maintenance
5.3104.2b	Appliance gas valve	When replacement is necessary, gas valve will be removed and replaced according to manufacturer specifications	Provide gas to burner when there is a call for heat Control volume of gas for burner Ensure the safe shut off of gas at the end of a call for heat
5.3104.2c	Ignition system	Components of ignition system will be repaired or replaced in accordance with manufacturer specifications	Do not allow flow of main burner gas without proof of ignition
5.3104.2d	Main gas burners	Problems that may interfere with flame (e.g., dust, debris, misalignment) will be cleaned, vacuumed, and adjusted	Produce combustion in a safe, clean, and efficient manner
5.3104.2e	Venting	Flue gases will be removed from the venting system in accordance with 2012 IRC G2427 or per manufacturer specifications	Ensure the safety and durability of the venting system
5.3104.2f	Flue gas testing	Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI-1100-T-2012 If combustion is not in compliance with BPI-1100-T-2012, diagnostics and adjustments will be done to meet manufacturer specifications or local codes	Confirm that combustion occurs safely with maximum efficiency
5.3104.2g	Combustion efficiency checks	Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with accepted protocol to determine if acceptable boiler efficiency is being maintained If boilers are found to be out of compliance, a combustion analysis will be administered and minimum stack temperature will be in accordance with manufacturer specifications	Increase the operational efficiency of the system Improve occupant comfort
5.3104.2h	Occupant health	All homes will have a carbon monoxide (CO) alarm	Ensure ambient CO does not exceed acceptable levels after completion of
5.3104.2i	Occupant education	Occupants will be educated on the operation and maintenance of the carbon monoxide (CO) alarm Completed work and recommended maintenance will be reviewed	Ensure occupant is informed of the safe and efficient operation and maintenance of the work performed

Maintenance: Checklist – Hydronic			
5.3104.3a	Health and safety	Combustion safety testing will be performed in accordance with the Health and Safety Chapter of the (Standard Work Specifications for Single Family Housing) or other equivalent practice	Identify potential health and safety issues
5.3104.3b	Visual inspection	The following conditions will be inspected: <ul style="list-style-type: none"> Water, steam, and fuel leaks Damaged or missing pipe insulation Venting issues – draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence) Corrosion (e.g., rust, mineral deposits) General condition of components 	Observe general conditions to determine needed repairs or maintenance
5.3104.3c	Pipe insulation inspection	Pipe insulation will be inspected, including: <ul style="list-style-type: none"> Integrity—complete coverage, no holes or tears Damage—holes or tears Complete coverage—insulation missing <p>If asbestos is suspected, occupants will be notified and asbestos will not be disturbed</p> <p>Required repair or replacement will be performed in accordance with the following conditions:</p> <ul style="list-style-type: none"> Materials will be approved for steam heating pipes Materials will be approved for hot water heating pipes Insulation will completely cover pipe <p>Pipe insulation will be installed in accordance with manufacturer specifications</p>	Minimize heat loss Improve performance of the system
5.3104.3d	Check system pressure	Check system pressure will be verified Check system pressure will be 1 pound per square inch gauge (psig) per 28" of system height	Keep system operating within pressure parameters

5.3104.3e	Purge system	Devices that are under performing or have need of purging will be purged as needed	Remove air from the system to maximize performance
5.3104.3f	Automatic fill	Automatic fill valve will be inspected to ensure it maintains system pressure If pressure is not maintained, replacement will be made in accordance with the following criteria: <ul style="list-style-type: none"> Valve will be replaced and include backflow prevention; existing backflow protection shall be tested to verify operation Components will be installed in accordance with manufacturer specifications Correct system pressure will be verified 	Maintain optimal system pressure to maximize performance
5.3104.3g	Gauge glass	Gauge glass will be inspected for erosion, cracks, or drying Damaged gauge glass on boiler will be replaced in accordance with manufacturer specifications Gauge glass that is coated with dirt or sediment, making it difficult to observe the water level of the boiler, will be removed, cleaned, and replaced	Ensure gauge glass is in safe operating condition to allow observation of water level in boiler
5.3104.3h	Low water cut-off: float type	Operation of low-water cutoff on steam boilers will be observed by opening blow-off valve If combustion is not extinguished, remediation will be accomplished by the following procedure: <ul style="list-style-type: none"> Electricity will be disconnected from boiler Problem will be diagnosed Low-water cutoff will be repaired, serviced, or replaced in accordance with manufacturer specifications A blow-down valve will be added, if not already present Boiler will be retested for proper operation Operation of low-water cutoff on hot water boilers is applicable only if proper test setup is available on-site, to avoid draining the system Occupants will be educated on the correct method to drain the low water cutoff weekly (must drain once per week to remove sediment from float chamber of low-water cutoff)	Ensure safe minimum water level of the boiler Maintain safe operation of the low water cut-off on ongoing basis
5.3104.3i	Low water cut-off: immersion	An immersion low-water cutoff will be installed and operable	Ensure safe minimum water level of the boiler
5.3104.3j	Expansion tank: non-bladder and bladder	An expansion tank will be installed and operable Tanks that leak or have excessive corrosion will be replaced, and non-bladder tanks will include an expansion tank drain Tank will be installed in accordance with manufacturer specifications Expansion tanks will be properly supported with strapping Tanks that are full of water will be drained; after expansion tank is drained, re-establish the correct water level in relation to system pressure Expansion tanks with bladders will have air charged to the manufacturer pressure specifications while water is not present in the tank Bladder tanks that have water inside of the air bladder will be replaced in accordance with manufacturer specifications	Absorb water expansion of the system
5.3104.3k	Flush or skim steam boiler	Manufacturer specifications for flushing or skimming steam boiler will be followed	Ensure boiler produces dry steam
5.3104.3l	System temperature or pressure gauge	The temperature or pressure gauge will be inspected for erosion, cracks, or dirt Damaged temperature or pressure gauges will be replaced in accordance with manufacturer specifications	Allow for accurate observation of system temperature and pressure
5.3104.3m	Circulators	Non-working motors that cannot be serviced will be replaced with a new motor New motors will be installed in accordance with manufacturer specifications Oil-lubricated circulators will be installed in proper alignment with the pump coupler and will be supported so they do not sag Bearings will have free movement without binding Shaft seals will not leak Bearings in inoperable, water-lubricated circulators will be freed, if possible, before replacement with a new circulation pump	Ensure circulation of water at designated velocity in system without leaks in the circulators

5.3104.3n	Zone valves	Zone valves will be inspected for the following conditions: <ul style="list-style-type: none"> Leaking water Not responding to a call for heat New equipment will be replaced in accordance with manufacturer specifications	Ensure proper zonal control of the system for comfort and efficiency
5.3104.3o	Condensate	If boiler is 90% efficient or more, condensate discharge will be an acceptable pH level, in accordance with local code, and will be drained to the exterior of the house, away from the foundation Condensate pumps will be installed, if needed, to ensure proper drainage	Bring the condensate to an acceptable pH and discharge to appropriate location
5.3104.3p	Temperature, pressure valves, and air vents	Occupant will be informed that air vents have potential to cause moisture problems if not operating properly Occupant will be reminded to call for maintenance if vents discharge steam or have moisture issues	Maintain efficient operation of the system
5.3104.3q	Maintenance records	Keeping records of all maintenance will be recommended to occupants Copies or access to installation and operation manuals will be provided	Provide a history of system installation and maintenance to improve future maintenance or
5.3104.3r	Occupant health and safety	All homes will have a carbon monoxide (CO) alarm	Ensure occupant health and safety
5.3104.3s	Occupant education	Completed work will be reviewed Occupants will be educated on the safe and efficient operation and maintenance of the system	Ensure occupant is informed of the safe, efficient operation and maintenance of the system

7420 Power Supply Inspection

The electric power supply for all applicable heating units shall be inspected for safety hazards at the time of the initial audit.

Evaluating Electrical Service			
5.3003.4a	Polarity	Polarity of equipment will be correct	Ensure equipment operates as designed Ensure equipment operates safely
5.3003.4b	Voltage/amperage: incoming power	Voltage/amperage will be in accordance with manufacturer specifications	Ensure equipment operates as designed
5.3003.4c	Voltage: contactor	In accordance with manufacturer specifications, voltage drop will be within acceptable range	Ensure contactor does not overheat Ensure equipment operates as designed
5.3003.4d	Grounding	Grounding must conform to meet NFPA 70 National Electric Code	Ensure equipment operates as designed Ensure equipment operates safely
5.3003.4e	Blower amperage	Amperage will not exceed manufacturer full load amperage	Ensure equipment operates as designed Ensure equipment operates efficiently Ensure equipment operates safely
5.3003.4f	Compressor amperage	Amperage will not exceed manufacturer full load amperage	Ensure equipment operates as designed Ensure equipment operates efficiently Ensure equipment operates safely
5.3003.4g	Door switch operation	Blower compartment safety switch operation will be verified	Ensure blower does not operate during service
5.3003.4h	Heat pump: emergency heat	Emergency heat circuit functions will be verified	Ensure system delivers heat in case of compressor failure

7430 Heating and Cooling Line Inspections

All fuel-fired heating units shall be inspected for leaks in the fuel supply at the time of the initial audit and again at the time of final inspection. Fuel leaks shall be corrected before weatherization can continue. All air conditioning units shall be inspected for refrigerant leaks at the time of the initial audit and again at the time of the final inspection.

Refrigerant Line Inspection

5.3003.5a	Insulation	All liquid refrigerant lines will be insulated to a minimum of R-4 Vapor or high side lines will not be insulated unless specified by the equipment's manufacturer Suction lines will be insulated to a minimum of R-4	Ensure refrigerant lines do not gain excessive heat
5.3003.5b	Ultraviolet (UV) protection of insulation	If exposed to sunlight, refrigerant line insulation will be protected from UV degradation in accordance with manufacturer specifications, 2012 IRC N1103.3.1, or local code	Install insulation so it does not degrade
5.3003.5c	Sizing	Refrigerant lines will be sized to meet manufacturer specifications for the installed equipment	Ensure system moves appropriate volume of refrigerant
5.3003.5d	Installation quality	Refrigerant lines will be installed without kinks, crimps, or excessive bends	Ensure system moves appropriate volume of refrigerant
5.3003.5e	Support	Refrigerant lines will be routed, supported, and secured to house in a manner that protects the line from damage by workers or occupants	Ensure refrigerant lines do not move, vibrate, or sag Protect lines from damage
2.0105.2d	Protective clothing	Long sleeves and long pants should be worn as additional protection from liquid refrigerants and other skin hazards	Protect worker from skin contact with liquid nitrogen

7440 Clearance from Combustibles

Heating units shall have sufficient clearance from combustible surfaces including walls, ceilings, floors, and framing members, as well as from items including stacks of newspapers, rags, oil, gasoline cans, and other such materials.

7450 Venting System Inspection

Functional combustion venting systems in weatherized dwellings including chimneys, flues, and all related venting components shall be inspected as per applicable standards listed herein to ensure that the systems are both safe and code compliant. For the purposes of the Installation Standards, a functional combustion venting system shall be defined as any system that is actively or could reasonably be placed in service with minimal effort by the dwelling occupants. Examples of nonfunctional exhaust venting systems shall include, but not be limited to, chimneys that have been permanently closed off and no longer penetrate the roof, which have been filled using some other permanent fill method, or which have been walled-in or covered-over in a manner which clearly indicates an intent to place the chimney permanently out of service.

While venting evaluation and installation requirements vary by venting system type and local code, all functional exhaust venting systems present in weatherized dwellings shall generally be evaluated to ensure that:

- A) Vent piping is properly rated for use on the unit type, fuel source, and in the environment to which it is exposed;
- B) Masonry chimneys are appropriately lined;
- C) Venting is free of obstructions, corrosion, residue, and deposits which may hinder proper drafting ;
- D) Venting components are well connected and sealed where applicable;
- E) Vent connectors are installed with adequate slope and the fewest elbows possible;
- F) Venting passing through the roof shall have compliant clearances from roofing materials;
- G) Where two units share a common main vent, the unit with the lower Btu input is vented above the higher Btu unit and the size of the common main vent is adequate to properly vent the Btu input of both units;
- H) Venting that is over sized due to removal of one or more combustion appliance (orphaned vents).

7460 Evaluating Air Flow

The airflow of forced air systems shall be evaluated to ensure they are operating within manufacturer's specifications.

Evaluating Air Flow			
5.3003.3a	Total air flow	Total system air flow will be measured by: <ul style="list-style-type: none"> • Temperature rise • Flow plate • Fan depressurization device (e.g., Duct Blaster, DucTester) 	Ensure equipment operates as designed Ensure equipment operates efficiently Ensure equipment provides comfort Ensure equipment operates safely Ensure equipment is durable
5.3003.3b	External static pressure	External static pressure will be in accordance with manufacturer specifications	Ensure equipment operates as designed Ensure equipment operates efficiently Ensure equipment provides comfort Ensure equipment operates safely Ensure equipment is durable
5.3003.3c	Pressure	Pressure drop across cooling coils will be in accordance with manufacturer specifications	Ensure equipment operates as designed Ensure equipment operates efficiently Ensure equipment provides comfort Ensure equipment operates safely Ensure equipment is durable
5.3003.3d	Pressure drop: filter	Pressure drop across filter will be in accordance with manufacturer specifications	Ensure equipment operates as designed Ensure equipment operates efficiently Ensure equipment provides comfort Ensure equipment operates safely Ensure equipment is durable
5.3003.3e	Balancing room flow: new ductwork	Air flow will be measured at each register to ensure proper air flow delivery	Ensure equipment operates as designed Ensure equipment operates efficiently Ensure equipment provides comfort Ensure equipment operates safely Ensure equipment is durable
5.3003.3f	Supply wet bulb and dry bulb	Supply wet bulb and dry bulb air temperatures will be recorded	Ensure equipment operates as designed Ensure equipment operates efficiently Ensure equipment provides comfort Ensure equipment operates safely Ensure equipment is durable
5.3003.3g	Return wet bulb and dry bulb	Return wet bulb and dry bulb air temperatures will be recorded	Ensure equipment operates as designed Ensure equipment operates efficiently Ensure equipment provides comfort Ensure equipment operates safely Ensure equipment is durable

7500 Heating, Ventilating, and Cooling System Repairs

Where conditions warrant major repairs or system replacement, weatherization service providers are strongly encouraged to identify a minimum of three alternate subcontractors to provide estimates or competitive bids to perform the installation or major repair work.

Repairs shall be considered cost-effective where repair expenses do not exceed 1/3 of the replacement cost of a comparable installed unit.

7600 HVAC System Replacements

Every effort shall be made to repair an existing heating system prior to considering replacement. Replacement shall be considered justified where repair expenses are equal to 1/3 or greater of the expense of a comparable replacement unit. A load calculation shall be used to determine correct sizing of central forced air replacement units taking estimated post-weatherization dwelling characteristics into consideration. Care shall be taken to ensure that the replacement unit is suitable for the dwelling and that associated system components including the location, power supply, venting, and duct systems are

compatible with the replacement system. Code requirements may require replacement of power supply and venting components. The inoperable/unsafe older system shall be surrendered by the owner and permanently removed from the dwelling and properly de-manufactured prior to proceeding with weatherization.

Inability by the dwelling occupants to supply fuel for an existing primary heat source(s) shall not constitute justification for a system replacement. Documentation justifying the necessity and dwelling owner authorization, as well as the specifications and selection criteria for every system installed, shall be maintained in the job file.

Preparation for New Equipment			
5.3002.1a	Access	A code compliant walkway and service platform will be installed in attics, if not present Walkway and platform will be above the level of insulation (if practical)	Ensure new equipment can be installed and serviced Maintain adequate insulation level
5.3002.1b	Utility disconnect	Electricity and fuel will be turned off prior to starting removal of old appliance	Protect workers and occupants from injury
5.3002.1c	Refrigerant recovery	Refrigerant will be recovered in accordance with 40 CFR 608 (EPA) by a licensed contractor	Comply with Safe Handling of Refrigerant Law Protect workers and occupants from injury
5.3002.1d	Equipment disconnection	Refrigerant lines, plumbing, ducts, electric, control wires, vents, and fuel supply will be disconnected	Ensure equipment can be removed
5.3002.1e	Removal	Equipment will be removed (e.g., furnace, air handler, evaporator, condensing unit) Equipment will be removed from space without damaging property and disturbing or compressing the insulation Equipment will be disposed of in accordance with local laws and regulations, recycling materials when feasible	Provide room to install new equipment and work safely Comply with applicable disposal laws

Data Plate Verification			
5.3003.1a	Data plate verification	Equipment will be visually inspected Information will be recorded from the equipment data plates indoors and outdoors	Ensure technician has equipment data necessary for commissioning and future service work

7610 Replacement System Efficiency Requirements

Installed heating systems shall have a rated performance efficiency of not less than the following:

Fuel Source	Coastal	Non-coastal	Space Heaters
Propane/Gas Furnace	85% AFUE	90% AFUE*	80% AFUE
Oil Furnace	85% AFUE	85% AFUE	80% AFUE
Propane/Gas Packaged Unit	80%	80%	Not applicable
Propane/Gas/Oil Boiler	80% AFUE	85% AFUE	80% AFUE
Heat Pump Split	8.2 HSPF	8.2 HSPF	Not applicable
Heat Pump Packaged	7.5 HSPF	7.5 HSPF	2.6 COP
Mini Split	Not applicable	Not applicable	8.5 HSPF
Wood Stove (logs)	Not applicable	Not applicable	72%
Wood Stove (pellets)	Not applicable	Not applicable	78%
AFUE-Annual Fuel Utilization Efficiency HSPF-Heating Seasonal Performance Factor COP-Coefficient Of Performance *90% or greater efficiency & unit must get its combustion air from outside the shell of the building.			

7620 Central Replacement System Sizing

All installed central heating systems shall be adequately sized for the dwelling based on a properly prepared load calculation. Preparation of a Manual J by the licensed HVAC subcontractor awarded the contract for installation of the unit is recommended. The WA software may also be used as a comparison guide. Please note that MHEA cannot be used to size the cooling load of a manufactured home. Weatherization service providers shall be responsible for ensuring the accuracy of the load calculations used to size installed systems. Load calculations shall reflect accurate dwelling-specific data including, but not limited to:

- A) Number of dwelling occupants
- B) Total square footage
- C) Wall, ceiling, and floor square footage
- D) Window schedule
- E) Associated local weather station
- F) Wall and window orientation
- G) Projected post-weatherization insulation value.

The weatherization service provider shall review the Manual J to ensure the inputs are consistent with dwelling. Where sizing calculations are performed for systems that include cooling, calculations shall be based on ensuring the cooling load for the dwelling is adequate. Where systems provide only heat, sizing shall be based on supplying the heating load for the dwelling only. In no instance shall a central HVAC system be sized to provide less than 50,000 Btu/hr input for site-built dwellings and 40,000 Btu/hr input for manufactured homes.

Notwithstanding the minimums previously expressed, fuel-fired central systems shall not exceed design specifications by greater than 25%. Heat pumps shall not exceed design specifications by greater than ½ ton.

Load Calculation and Equipment Selection			
5.3001.1a	Load calculation	Load calculation will be performed in accordance with ANSI/ACCA 2 Manual J-2011 (Residential Load Calculation) and manufacturer specifications	Properly size equipment for load
5.3001.1b	Equipment selection	Equipment selection will be performed in accordance with ANSI/ACCA Manual S and manufacturer specifications	Ensure equipment is able to heat, cool, and dehumidify the house
5.3001.1c	Air filtration	New central forced air HVAC systems will have minimum MERV 6 filtration with no air bypass around the filters	Particle removal to protect equipment and help maintain indoor air quality

Heat Load Calculation—Whole House			
5.3101.1a	Heating load calculation	Load calculation will be performed in accordance with ANSI/ACCA 2 Manual J-2011 (Residential Load Calculation) and manufacturer specifications	Enable proper sizing of the heating appliance
5.3101.1b	Equipment selection	Equipment selection will be performed in accordance with ANSI/ACCA Manual S and manufacturer specifications	Ensure equipment is able to heat the house

Preparation for New Equipment			
5.3002.1a	Access	A code compliant walkway and service platform will be installed in attics, if not present Walkway and platform will be above the level of insulation (if practical)	Ensure new equipment can be installed and serviced Maintain adequate insulation level
5.3002.1b	Utility disconnect	Electricity and fuel will be turned off prior to starting removal of old appliance	Protect workers and occupants from injury
5.3002.1c	Refrigerant recovery	Refrigerant will be recovered in accordance with 40 CFR 608 (EPA) by a licensed contractor	Comply with Safe Handling of Refrigerant Law Protect workers and occupants from injury
5.3002.1d	Equipment disconnect	Refrigerant lines, plumbing, ducts, electric, control wires, vents, and fuel supply will be disconnected	Ensure equipment can be removed
5.3002.1e	Removal	Equipment will be removed (e.g., furnace, air handler, evaporator, condensing unit) Equipment will be removed from space without damaging property and disturbing or compressing the insulation Equipment will be disposed of in accordance with local laws and regulations, recycling materials when feasible	Provide room to install new equipment and work safely Comply with applicable disposal laws

7630 Heating System Fuel Source Switching

Where it is determined that an existing heating system shall be replaced based on the standards listed herein for allowable heating system replacements, every effort shall be made to provide a replacement system that is comparable to the system being removed, including installation of a system with the same associated fuel source.

Weatherization service providers may consider replacement units with different fuel sources and configurations on a limited case-by-case basis only. Authorization from NC WAP shall be required prior to any system replacement where fuel switching occurs.

Where authorization for fuel switching is requested, weatherization service providers shall compile a cost analysis comparing the expenses related to:

- A) Installation of a comparable replacement system with the same associated fuel source (i.e., replacing a nonfunctioning central oil furnace with a new central fuel oil furnace).

Versus

- B) Installation of a comparable replacement system with a different proposed fuel source (i.e., replacing a nonfunctioning central fuel oil furnace with a new electric heat pump).

A complete fuel switching cost analysis shall consist of not less than 2 estimates for the installation of each system type, prepared by a licensed HVAC subcontractor. Each of the estimates prepared shall include all expenses associated with the purchase and installation of both proposed replacement systems. Such estimates shall include, but not be limited to:

- A) Base system price plus all additional materials required;
- B) Efficiency of each system compared;
- C) Fuel lines or piping and associated fuel tanks where applicable;
- D) Labor expenses to install each replacement unit and remove the existing unit;
- E) Thermostat replacement;
- F) Required permits;
- G) Ductwork repairs or modifications;
- H) Sole source justification (if applicable).

Fuel switching shall only be authorized on the basis of the cost-effectiveness to the program. Fuel switching shall not be authorized where an existing unit is functioning properly or where cost-effective repairs to an existing system are possible.

7700 Water Heater Repair and Replacement

Allowable water heater repair measures shall include:

- A) Flushing the tank;
- B) Replacing heating elements (electric);
- C) Replacing ignition mechanisms (fuel-fired).

Water heaters shall be replaced on a case-by-case basis where units are nonfunctioning or functioning improperly and cannot be repaired. Replacement of a conventional residential water heater would rarely, if ever, be justifiable based on an SIR greater than 1.0; therefore, most replacements can be justified only as a health and safety measure. Installed water heaters shall be comparable to the existing unit in size, construction, operation, and fuel source. If combustion water heater is selected, a low nitrogen oxide burner will be required. The inoperable/unsafe older water heater shall be surrendered by the owner and permanently removed from the dwelling and properly demanufactured prior to proceeding with weatherization.

Installed water heaters shall have an energy efficiency factor of not less than:

Water Heater Capacity	Gas	Electric
30 Gallons	0.63 EF	0.94 EF
40 Gallons	0.62 EF	0.93 EF
50 Gallons	0.59 EF	0.92 EF
EF-Energy Factor		

Water Heater Selection			
7.8102.1a	Selection parameters	<p>Equipment will provide sufficient, affordable, safe, and healthy hot water for the occupant in accordance with 2012 IRC P2801</p> <p>Potential for solar hot water heating or other renewable energy systems will be assessed in selecting the hot water equipment</p> <p>Potential for health and safety hazards (e.g., backdrafting, flame rollout, obstructions) will be assessed in selecting equipment and the cost of remedying such problems will be included in any cost and benefit calculations</p> <p>If a combustion based system is selected, it will be either direct vented or power vented, and ENERGYSTAR qualified</p> <p>If combustion equipment is selected, a low nitrogen oxide burner will be included</p> <p>Equipment will be functional at high efficiency under all load conditions</p> <p>Standby losses will be reduced to maximum potential</p> <p>Fuel type will be selected based on affordability to occupant</p> <p>Equipment will be freeze resistant or installed in a conditioned space</p> <p>Efficiency of equipment will be maintained throughout life of system</p> <p>Occupant control of hot water temperature will be provided on the equipment</p> <p>The following will be determined from the occupant:</p> <ul style="list-style-type: none"> • Lifestyle • Current and future needs • Space considerations • Fuel options • Health and safety considerations • Appliance options • Maintenance and operation costs • Return on investment concerns 	<p>Save energy and water</p> <p>Protect the environment</p> <p>Identify appliance options based on the needs and wants of the occupant</p>
7.8102.1b	Product selection	<p>Water heater will be selected based on performance requirements of the occupant, available fuel sources, energy efficiency, and total life cycle cost</p> <p>In very cold climates, on-demand water heaters will be sized to meet the demand of water flow at very low water intake temperatures</p> <p>When evaluating an existing thermal solar water heating system, a solar expert should be consulted</p> <p>The proper installation and maintenance of solar hot water systems is provided in the Uniform Solar Energy Code (USEC) and 2012 IRC Chapter 23</p>	<p>Ensure equipment meets the occupant's expectations while providing efficient energy and water use</p>
7.8102.2a	Hazardous material removal	<p>Health concerns in the removal and replacement of equipment (e.g., asbestos, other hazardous materials) will be identified</p> <p>Written notification will be provided to occupants of the discovery of hazardous material, including contact information for regional EPA asbestos coordinator</p> <p>Occupant will be asked to contract with an EPA-certified asbestos contractor to conduct abatement before equipment removal and replacement (occupant is responsible for abatement or remediation)</p>	<p>Remediate health hazards using EPA-certified contractors</p>
7.8102.2b	Equipment removal	<p>Accepted industry procedures and practices will be followed to:</p> <ul style="list-style-type: none"> • Remove old water heater and associated components in accordance with 2012 IRC R105.1 or authority having jurisdiction • Seal any unused chimney openings and penetrations in accordance with 2012 IRC N1102.4.1.1 or authority having jurisdiction • Remove unused oil tank, lines, valves, and associated equipment in accordance with 2012 IRC M2201.7 or authority having jurisdiction <p>All work shall be completed by a licensed plumbing professional where required by the authority having jurisdiction and installed to industry-accepted standards</p>	<p>Ensure the safety of the workers and occupants</p> <p>Preserve integrity of the building</p> <p>Remove old equipment in a timely and efficient manner</p>

7.8102.2c	New equipment installation	<p>New water heater and associated components will be installed to accepted industry standards, in accordance with the 2012 IRC and manufacturer specifications</p> <p>The system will be installed to be freeze resistant</p> <p>Any existing water leaks will be repaired before installation begins</p> <p>Any penetrations to the exterior of the home created by the installation of the equipment will be sealed</p>	<p>Ensure the safety of the workers and occupants</p> <p>Preserve integrity of the building</p> <p>Remove old equipment in a timely and efficient manner</p>
7.8102.2d	Emergency drain pan	<p>An emergency drain pan will be installed with sides that extend a minimum of 4" above floor if leakage would cause damage to the home and in accordance with P2801.5 of the 2012 IRC</p> <p>A ¾" drainline or larger will be connected to tapping on pan and terminated in accordance with P2801.5.2 of the 2012 IRC</p>	Collect and safely dispose of water escaping from the storage tank
7.8102.2e	Expansion tank	<p>A potable water expansion tank will be installed on the cold water side</p> <p>A direct connection with no valves between the storage tank and expansion tank will be installed in accordance with the 2012 IRC, authority having jurisdiction, and according to manufacturer specifications</p>	Protect the storage tank from expansion
7.8102.2f	Temperature and pressure relief valve	<p>Correct temperature and pressure relief valve will be installed in compliance with P2803 of the 2012 IRC and according to manufacturer specifications</p> <p>Temperature and pressure relief valve discharge tube will be installed in accordance with P2803.6.1 of the 2012 IRC</p>	Discharge excessive energy (pressure or temperature) from storage tank to safe location
7.8102.2g	Dielectric unions	Dielectric unions will be installed in accordance with the 2012 IRC, authority having jurisdiction, and according to manufacturer specifications	Break the stray voltage electrical circuit through the storage tank
7.8102.2h	Backflow prevention	Backflow prevention will be installed in accordance with manufacturer specifications and all applicable codes	Protect water supply from contamination
7.8102.2i	Thermal efficiency	<p>If additional tank insulation is installed, it will be rated a minimum of R-5 and will be installed to manufacturer specifications</p> <p>If additional insulation is installed, it will be installed based on fuel type, making sure not to obstruct draft diverter, pressure relief valve, thermostats, hi-limit switch, plumbing pipes or elements, and thermostat access plates</p> <p>The first 6' of inlet and outlet piping will be insulated in accordance with manufacturer specifications</p> <p>Pipe insulation must remain 3" from gas water heater vent</p> <p>Heat traps will be installed on the inlet and outlet piping where not provided by manufacturer</p>	<p>Reduce standby loss from near tank piping and storage tank</p> <p>Ensure insulation does not make contact with flue gas venting</p>
7.8102.2j	Fuel supply	Electric or fossil fuel supply components will be installed to accepted industry standards as per NFPA 31 and 54, or NFPA 70 National Electric Code (NEC) for electric components, or authority having jurisdiction	Provide sufficient fuel to the water heater, burner, or element
7.8102.2k	Discharge temperature	Discharge temperature will be set not to exceed 120° or as prescribed by local code	Ensure safe hot water supply temperature to fixtures
7.8102.2l	Commissioning of system	<p>The following will be checked once the system has been filled and purged:</p> <ul style="list-style-type: none"> • Safety controls • Combustion safety and efficiency • Operational controls • Fuel and water leaks • Local code requirements <p>Commissioning will be in compliance with manufacturer specifications and relevant industry standards</p>	<p>Ensure safe system function</p> <p>Keep cost of ownership as low as possible</p>
7.8102.2m	Occupant safety	<p>Carbon monoxide (CO) alarms will be installed in each dwelling in accordance with ASHRAE 62.2 and authority having local jurisdiction</p> <p>Occupant will be provided information regarding the health effects and risk of high CO concentrations as well as a list of monitors that can provide more detail regarding CO levels</p>	Ensure occupant life safety; CO alarms are designed to detect levels at which occupants might become unable to evacuate
7.8102.2n	Occupant education	<p>Completed work will be reviewed</p> <p>Occupants will be educated on the safe and efficient operation and maintenance of the system, including:</p> <ul style="list-style-type: none"> • Adjustment of water temperature and target temperature in accordance with local code • Periodic drain and flush • Expansion tank and backflow preventer (no occupant maintenance required) • Periodic inspection, maintenance, or replacement 	Ensure occupant is informed of the safe, efficient operation and maintenance of the system

7710 Heat Pump Water Heaters

ENERGY STAR qualified heat pump water heaters utilizing super-efficient technology can cut residential water heating costs substantially. As of the effective date of the Installation Standards, all known heat pump water heaters available have a minimum tank capacity of 50 gals, and due to their construction and method of operation such units cannot be installed in small or tightly enclosed areas.

Heat pump water heaters shall be allowable as an energy conservation measure when installed in dwellings where:

- A) Adequate circulation and utility space exists in the dwelling to accommodate the new appliance
- B) The existing water heating fuel source is electricity
- C) Dwelling occupancy supports the capacity of the new appliance
- D) The capacity of the existing and new appliances have a difference of less than 11 gals
- E) A dwelling specific NEAT or MHEA evaluation yields an SIR of 1.0 or greater for the measure.

7800 Window Air Conditioner Guidelines

Where functioning window or room air conditioners are present in weatherized dwellings, it shall be serviced per manufacturer specifications. This includes cleaning filters, coils, and fan blades, in addition to straightening the coil fins as needed. Repairs to nonfunctioning window or room units shall be allowed on a limited case-by-case basis where repair expenses do not exceed 50% of the expense of an installed replacement unit.

While not a cost-effective energy efficiency measure, window air conditioner installation or replacement shall be allowed where necessary to provide at least *one* “cooling room” for at-risk clients as a health and safety measure in dwellings in which no cooling exists. Where installed, units shall have an Energy Efficiency Ratio (EER) of 10.0 or greater, shall not exceed 115 volts, and shall not be equipped with remote control devices. A maximum of one unit shall be provided per dwelling.

Window air conditioners shall be air sealed per applicable air sealing standards. Client education shall be provided on operating expenses, maintenance, and energy losses associated with allowing window units to remain installed year round. Installation of prefabricated air conditioner covers shall be allowed.

7900 Thermostat Installation

7910 Smart Thermostats

When properly programmed and consistently used, smart thermostats, also referred to as programmable or setback thermostats, can be an effective tool to reduce the energy consumption of central HVAC systems. Despite the potential benefits, smart thermostats are more often used improperly, negating any potential benefits and resulting in frustration for clients.

Smart thermostats shall be installed only where the dwelling occupants are both willing and capable of properly operating the device, and where written authorization from the dwelling owner is obtained. When installed, smart, programmable, or setback thermostats shall comply with the following specifications:

- A) Be equipped with a large digital display
- B) Be hard-wired with a battery backup
- C) Be equipped with the Smart Response/Adaptive Recovery/Smart Recovery feature
- D) For heat pumps, be equipped with a control to lockout strip heat based on an outdoor temperature of above 40°F if one is not installed.

7920 Mercury Bimetal Thermostats

Existing mercury bimetal thermostats located in site-built dwellings shall only be replaced where they are nonfunctioning and cannot be repaired. Servicing a mercury bimetal thermostat should consist of leveling the device as well as testing the anticipator with an ammeter to ensure it is operating within manufacturer specifications as listed on the device. If these adjustments fail to correct the malfunction then the thermostat may be replaced with a basic digital or smart thermostat. Documentation of repair efforts made on the existing device prior to replacement shall be maintained in the job file.

Heating and Cooling Worker Safety			
2.0105.2a	Worker safety	Follow all worker safety specifications in Global Worker Safety section	Prevent injury Minimize exposure to health and safety hazards
2.0105.4b	Mercury	Identify and dispose of any mercury-containing thermostats in accordance with Environmental Protection Agency (EPA) guidance	Protect worker and occupant from mercury exposure

Heating and Cooling Controls			
5.3003.9a	Removal of mercury-based thermostats	Mercury based thermostat will be removed safely and disposed of in accordance with EPA regulations	Protect workers and occupants from injury Protect environment from damage

7930 Digital Thermostats

Basic or nonprogrammable digital thermostats are not equipped with energy efficiency features and shall therefore only be installed as a replacement for an existing nonfunctioning basic digital thermostat, or for a nonfunctioning bimetal mercury thermostat which cannot be repaired.

Weatherization service providers shall educate clients on the proper operation of the particular type of thermostat in use in the dwelling.

2.0105.2b	Mercury	When replacing existing thermostats, identify and dispose of any mercury containing thermostats in accordance with Environmental Protection Agency (EPA) guidance	Protect workers and occupants from mercury exposure
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8000 Duct Sealing and Insulating

Sealing and insulating the distribution system or ductwork for forced air heating systems can improve system efficiency and comfort for dwelling occupants.

Ductwork present in all accessible unconditioned areas of weatherized dwellings shall be sealed to a tightness or pressure of 1.0 Pa or below.

Duct tightness testing using the blower door and pressure pan or a duct blower shall be performed to monitor the effectiveness of duct sealing measures, ensuring complete tightness is achieved. Duct sealing and insulating measures shall not be required where portions of a distribution system are inaccessible due to location or immovable obstructions.

Duct sealing and insulating measures shall generally be performed by weatherization personnel. The initial energy audit shall be used to identify required duct repairs or replacements, where present. Where duct connections must be repaired or replaced prior to sealing and insulating, applicable local codes shall govern requiring such work be performed only by licensed HVAC technicians.

Client education shall be provided reinforcing the importance of maintaining unrestricted airflow throughout the system.

8100 Duct Sealing Preparation

Prior to performing duct sealing measures, weatherization personnel shall ensure that:

- A) Faulty connections in the duct system have been repaired or replaced per applicable local code
- B) Supply registers located in conditioned space are open, operable, and unrestricted
- C) Supply and return ducts are clear of obstructions and debris
- D) Ducts connecting to unconditioned spaces (for example, an attached garage) have been sealed in a manner which permanently restricts airflow
- E) Oily residues or deposits (where present) have been cleaned using a solvent such as mineral spirits or denatured alcohol
- F) Duct runs are supported with industry standard straps in a manner that prevents sagging in accordance with manufacturer specifications, but at no greater distance than every 4 feet so that there is no greater than 6 inches of sag per foot of spacing between supports
- G) Compliant procedures for addressing ductwork treated with tape or other materials suspected of containing asbestos have been implemented per applicable standards listed herein for asbestos hazard management

Preparation and Mechanical Fastening			
4.a	Preparation	Type and R-value of existing duct insulation (e.g., fiberglass, stone wool, asbestos) will be identified as will the location of vapor retarders, if any If asbestos insulation was used, it will not be disturbed; consult with an asbestos abatement expert for removal Surrounding insulation will be cleared to expose joints being sealed Duct surface to accept sealant will be cleaned Insulation will be returned or replaced with equivalent R-value	Gain access while maintaining insulation value Achieve proper adhesion for airtight seal

3.1601.1b	Metal to metal	Round ducts will be fastened with a minimum of three equally spaced screws Other shaped ducts will be securely fastened and sealed with welds, gaskets, mastics (adhesives) and mastic-plus-embedded-fabric systems	Ensure durable joints
3.1601.1c	Flex to metal	Joints will be fastened with tie bands using a tie band tensioning tool	Ensure durable joints
3.1601.1d	Duct board to duct board	Joints will be fastened with clinch stapler	Ensure durable joints
3.1601.1e	Flexible duct to duct board	Metal take-off collar will be used and attached in accordance with 2012 IRC M1601.4.1	Ensure durable joints
3.1601.1f	Metal plenum to air handler cabinet	Plenum will be mechanically fastened	Ensure durable joints
3.1601.1g	Duct board plenum to air handler cabinet	Termination bar or metal strip will be fastened with screws Duct board will be installed between the screw and the termination bar	Ensure durable joints
3.1601.1h	Boot to wood	Screws or nails will be used to fasten boot to wood	Ensure durable joints
3.1601.1i	Boot to gypsum	Boot hanger will be fastened to adjacent framing with screws or nails Boot will be connected to boot hanger with screws Integral snap boots will be installed	Ensure durable joints
3.1601.1j	Flex to duct board	Take-offs will be in accordance with 2012 IRC Chapter 16, 2012 IRC N1103.2, and applicable local code	Ensure durable joints
3.1601.3a	Support (applies to all duct types)	Flexible and duct board ducts and plenums will be supported every 4' using a minimum of 1 1/2" wide material Support materials will be applied in a way that does not crimp ductwork or cause the interior dimensions of the ductwork to be less than specified (e.g., ceiling, framing, strapping); duct support must be installed in accordance with authority having jurisdiction Metal ducts will be supported by 1/2 inch wide eighteen gauge metal straps or 12-gauge galvanized wire at intervals not exceeding 10 feet or other approved means	Eliminate falling and sagging

8200 Duct Sealing

A) Material Selection

Only duct mastic and fiberglass mesh tape listed for use in HVAC applications shall be used to seal ductwork. Spray polyurethane foam, cloth duct tape, and other such materials not intended for use on ducts shall not be allowed. All materials shall be installed per manufacturer specifications to the extent such specifications do not conflict with the minimum standards listed herein.

Duct mastic shall have the following specifications:

- be non-toxic and moisture/mold resistant
- be UL Listed and labeled per UL 181A or 181B standards
- be compatible for use on the duct material to which it is applied
- be either fiberglass infused, silicone infused, or fiber reinforced and have a 50% solids content

Draw bands used to support or secure ductwork shall have the following specifications:

- consist of weather-resistant and UV-resistant material, or stainless steel worm drive clamps
- be corrosion resistant

B) Application

Detached boot connections repaired by HVAC technicians shall be firmly reattached to the subfloor, taking care to prevent materials from inhibiting register grilles from fitting properly into the boot.

All ductwork located outside the conditioned space including plenums and returns, shall be sealed. Emphasis shall be placed on effectively sealing boot-to-subfloor connections and all accessible joints.

Gaps between existing components of less than ¼ in. may be sealed using only duct mastic as long as the components are greater than 10 ft. away from the air handler (within 10 ft. mastic and self-adhesive fiberglass mesh tape shall be used). Gaps of ¼ in. up to ¾ in. shall be sealed using duct mastic with self-adhesive fiberglass mesh tape. Gaps of ¾ in. or greater shall be treated by applying sheet metal or valley flashing fastened with screws, then sealed with mastic.

Where noncompliant cloth duct tape is present on ductwork, ducts may be effectively treated by applying mastic and fiberglass mesh tape atop the existing cloth duct tape in the same manner specified herein, taking care to achieve a durable, tight seal by applying the materials a minimum of 1 in. beyond the edges of the existing cloth tape.

Air Sealing Duct System			
3.1602.1a	New component to new component sealant selection	Any closure system used will be in accordance with 2012 IRC Chapter 16	Ensure effectiveness of air sealing system
3.1602.1b	New component to existing component	<p>Seams, cracks, joints, holes, and penetrations less than ¼" will be sealed using fiberglass mesh and mastic</p> <p>Mastic alone will be acceptable for holes less than ¼" that are more than 10' from air handler</p> <p>Seams, cracks, joints, holes, and penetrations between ¼" and ¾" will be sealed as follows:</p> <ul style="list-style-type: none"> They will be backed using adhesive fiberglass mesh (for support) and mastic 	<p>Eliminate air leakage into or out of ducts and plenums</p> <p>Ensure adhesion of primary seal (mastic and fiberglass mesh) to the duct</p> <p>Reinforce seal</p> <p>Support mastic and fiberglass mesh during curing</p>
3.1602.1c	Existing component to existing component	<p>Fiberglass mesh and mastic will overlap temporary tape by at least 1" on all sides</p> <p>Fiberglass mesh and mastic will become the primary seal</p> <p>Seams, cracks, joints, holes, and penetrations larger than ¾" will be repaired using rigid duct material</p> <p>Fiberglass mesh and mastic will overlap repair joint by at least 1" on all sides</p> <p>Fiberglass mesh and mastic will be the primary seal</p>	<p>Eliminate air leakage into or out of ducts and plenums</p> <p>Ensure adhesion of primary seal (fiberglass mesh and mastic) to the duct</p> <p>Reinforce seal</p> <p>Support fiberglass mesh and mastic during curing</p>
3.1602.4a	Duct boot to interior surface	<p>All gaps between boot and interior surface will be air sealed</p> <p>Gypsum edge will be wetted before applying water-based sealant</p> <p>Sealants will be continuous and be in accordance with 2012 IRC R302.9</p>	<p>Prevent air leakage</p> <p>Prevent a fire hazard</p>
3.1602.4b	Wooden plenums and building cavities	Accessible connections and joints will be made airtight using approved material	Ensure ducts and plenums will not leak
3.1602.4c	Air handler cabinet	Joints will be closed and cracks and holes not needed for proper function of unit will be sealed using removable sealant (e.g., foil tape) or in accordance with the original equipment manufacturer directions (if available)	Reduce air leakage while maintaining accessibility
3.1602.4d	Filter slot	A pre-manufactured or site manufactured durable filter slot cover will be installed	Reduce air leakage while maintaining accessibility

8300 Duct Insulation

Prior to installing insulation, ductwork shall be repaired and sealed per applicable standards listed herein. Ductwork and plenums located within *conditioned space* shall not be insulated.

Accessible ducts and plenums located in *unconditioned space* shall be insulated to a minimum value of R-8. Duct insulation measures shall comply with the following specifications:

- A) Installed with reinforced foil-wrapped to prevent deterioration due to UV light.
- B) Installed with the vapor barrier on the outside such that it covers the insulation.
- C) Shall not be compressed by greater than 50%.
- D) Shall not be installed where ducts or heating pipes are located within 3 inches of heat-producing devices like flue pipes.
- E) Ductwork insulated to a value of R-4 or greater shall be repaired as needed, but no additional insulation shall be installed.

Care shall be taken to properly identify areas of unintentionally pressure-connected space. The space must be assessed to determine if the space will remain a pressure-connected or if measures will be done to disconnect the space from the rest of the dwelling. Unintentionally pressured-connected spaces are defined as spaces having zonal pressures not greater than 10 Pa WRT the house including, for example, basements, dropped ceilings, and HVAC chases. Ducts located in unintentionally pressure-connected space shall not be insulated. Air handler units, gas packs, and combustion exhaust venting shall never be insulated.

Insulating Flex Ducts			
5.301.1a	Removal of existing flexible ducting	All accessible low R-value flexible ducting will be removed from premises	Ensure installation of proper R-value ducts
4.1601.1b	Selection of new flexible ducting	All flexible ducting will have a minimum of R-8	Minimize thermal conductance of the duct system
4.1601.1c	Sizing of new flex	Duct sizing procedures will be conducted when replacing flex duct	Improve comfort in rooms Improve fan performance
4.1601.1d	Installation of flex	Flexible ducts will be supported in accordance with flex duct manufacturer's directions or local codes	Prevent sags, drops, or other bends that may interfere with correct air flow
4.1601.1e	Interior liner attachment	Interior liner of the flex-to-metal connection will be fastened with tie bands using a tie band tensioning tool or a mechanical band	Create a strong, secure attachment
4.1601.1f	Sealing of interior liner	Systems used to seal flexible air ducts and flexible air connectors will comply with UL 181B and will be marked "181 B-M" for mastic	Create an airtight connection
4.1601.1g	Attachment of exterior liner	Liner will be pulled up onto the metal duct as far as possible before securing The exterior liner of the flex duct will be fastened with tie bands using a tie band tensioning tool	Create a strong, durable attachment
4.1601.1h	Sealing of all accessible ducts	All accessible joints, seams, and connections in ductwork will be securely fastened and sealed with UL "181 B-M" compliant mastic (adhesives) or mastic-plus-embedded-fabric systems	Minimize duct leakage
4.1601.1i	Insulation of all fittings	All metal fittings including boots, elbows, and take-offs will be insulated separately using an R-8 duct wrap with vapor retarder	Minimize thermal conductance of the duct system
4.1601.1j	Completeness of vapor barrier	Vapor retarder of all duct insulation will be taped to the flex duct using tape that complies with UL 181B and will be marked "181 B-FX" for pressure-sensitive tape or "181 B-M" for mastic	Ensure a complete vapor barrier

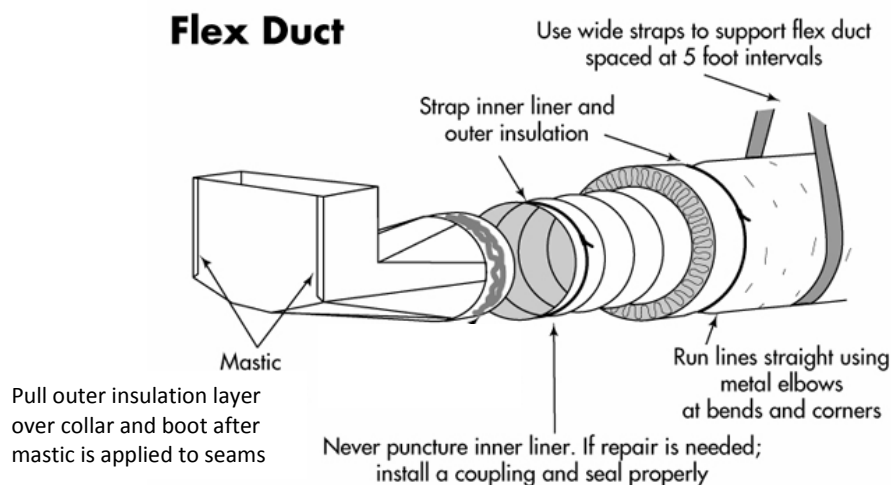
Insulating Metal Ducts

4.1601.2a	Selection of duct insulation material	Duct insulation on all ducts located in unconditioned spaces will be a minimum of R-8, in accordance with local code, or buried under attic insulation, whichever is greater, and have an attached vapor retarder Hot humid and warm coastal regions will not bury ducts	Decrease heat loss and condensation problems
4.1601.2b	Duct sealing	All joints, seams, and connections in ductwork shall be securely fastened and sealed with UL 181 B-M mastics (adhesives) or mastic- plus-embedded-fabric systems installed in accordance with the manufacturer's instructions before insulation is applied	Minimize duct leakage
4.1601.2c	Attachment of duct insulation	Duct insulation will be secured to the duct system using metal wire or rot-proof nylon twine Pattern of the wire or twine will be sufficient to securely hold the duct insulation tight to the duct	Ensure a secure connection between the duct system and the duct insulation
4.1601.2d	Taping of the duct insulation	Using a tape approved by the manufacturer, all seams and connection of the duct insulation will be taped No gaps will exist between pieces of duct insulation	Prevent gaps in the vapor barrier of the insulation

8310 Flex-Duct-to-Boot-Collar Connections

Where flex duct is attached to boot collars, the connection shall be sealed as follows:

- A) Ensure flex duct and boot are well connected and the metal collar is clean.
- B) Apply a band of mastic approximately 2 in. wide around the entire circumference of the existing collar connection.
- C) Pull any loose inner liner up and over the collar and mastic and secure with a code-compliant tie.
- D) Pull outer insulation layer and liner up and over the collar (taking care to fully insulate the boot) and secure with a code-compliant tie.
- E) Apply additional mastic atop the joint to form a complete seal between the duct liner *and* the adjoining surface.



8400 Distribution System Replacement

Every effort shall be made to repair existing distribution system components before replacement is considered. Where complete or major ductwork replacement is required, weatherization service providers shall be

responsible for documenting the need for the replacement (including photographs) in the job file. Installation methods and materials used for distribution system replacements shall comply with manufacturer specifications and local code. Duct distribution systems shall not be installed in dwellings that do not have a forced air duct system at the initial audit.

Efforts shall be made to replace panned returns wherever major components of the system are being replaced. Where all or the majority of a distribution system is replaced, all primary supply plenums for distribution of air shall be comprised of rigid duct. Panned floor joists used as supply or return runs shall not be allowed.

Distribution system components shall be sized according to the most current ACCA, Manual D, Residential Duct Systems specifications.

Distribution system replacements shall be completed in a manner which ensures that ductwork:

- A) Is not located in exterior walls
- B) Is not formed using building frame cavities, closets, crawl spaces, or chases for distribution
- C) Does not use panned floor joists
- D) Is not crimped.

Flex duct shall be allowed per applicable code for replacement ductwork installation.

3.1602.7a	Supply plenums (includes conditioned crawl spaces)	Basements and crawl spaces that are used as heating and cooling supply plenums will not be allowed	Improve IAQ in the living space Eliminate connection between the crawl space and living space Achieve energy impacts
3.1602.7b	Return plenums	Basements and crawl spaces that are used as heating and cooling return plenums will not be allowed	Improve IAQ in the living space Eliminate connection between the crawl space and living space Achieve energy impacts

8410 Removal of Vents from Unconditioned Space

Supply and return vents found outside the defined conditions space (such as garages, uninsulated porches, unfinished attics) shall be removed.

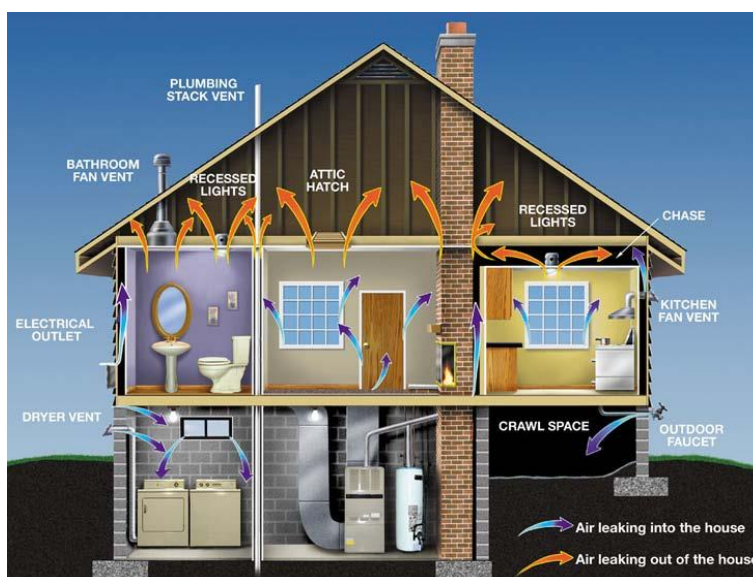
Removing Supply Vents from Garages			
6.6188.1a	Removal of supply/return in garage	Supply run feeding the register will be truncated as near to the supply plenum as possible If directly connected to the plenum, it will be truncated at the plenum If connected to a Y or T branch system, it will be truncated at the Y or T Return grille located in garage will be removed in the same manner as supply	Minimize surface area of duct
6.6188.1b	Patching of the hole in the duct system created by removal	All holes in sheet metal ducts will be patched with sheet metal and secured with sufficient screws to hold the patch flat without gaps Holes left in any Y or T will be capped with sheet metal caps and fastened with at least three screws	Ensure a secure and strong patch
6.6188.1c	Sealing of the patch	All patches will be sealed with mastic meeting UL 181M and in accordance with manufacturer specifications	Ensure an airtight patch
6.6188.1d	Removal of discarded ducts	All abandoned ductwork will be removed from work area	Provide a clean work site

6.6188.1e	Patching of the register hole in garage	Hole created by the removal of the register and boot will be patched and taped using material meeting local codes	Prevent a fire hazard
6.6188.1f	External static pressure testing	Units will be tested for external static pressure (ESP) before and after work If there is a significant rise in ESP, air flow testing will be required	Ensure correct fan performance

9000 Air Sealing Measures

Air infiltration can account for 30% or more of heating and cooling costs in a dwelling and contribute to moisture problems, dust, and the entry of pollutants, insects, and rodents. Reducing infiltration can significantly cut annual heating and cooling costs, improve building durability, and create a healthier indoor environment.

Every dwelling weatherized shall be evaluated to identify air infiltration or leakage sources caused by penetrations in the building envelope, as well as thermal bypasses where heat loss may occur. All air infiltration sources identified which can be corrected cost-effectively through performance of allowable air sealing measures shall be fully addressed.



Repair work required to alleviate poor Indoor Air Quality (IAQ) issues shall be completed prior to performing air sealing measures including, but not limited to, eliminating moisture problems, reducing elevated CO levels, correcting noncompliant combustion appliance venting, etc.

A properly calibrated blower door and infrared camera shall be used to guide the air sealing by helping to diagnose sources of air leakage not easily identified by visual inspection. Air sealing measures shall generally be performed until sealing is no longer cost-effective.

Air sealing measures shall address primary sources of air leakage first, followed by duct leakage, then progress to discrete or secondary leakage sources. Air sealing shall be prioritized beginning with the attic or uppermost areas of the dwelling, and ending with the crawl space or lowest area of the dwelling.

Air sealing measures shall be performed regardless of performance of related measures including, but not limited to, attic, sidewall, floor, or duct insulation.

9100 Air Sealing Precautions

Applicable standards specifying appropriate handling and use limitations for hazardous materials shall apply to all materials and installation methods employed during the performance of air sealing measures including, but not limited to, restrictions on the use of spray polyurethane and extruded polystyrene foam products.

2.0103.1a	Worker safety	All worker safety specifications in Global Worker Safety section will be followed	Prevent injury Minimize exposure to health and safety hazards
4.9901.1		General Information on Spray Polyurethane Foam (SPF)	

Low-Pressure SPF

Low-pressure SPF systems are two-component polyurethane foam products. They are typically delivered to the job site in pressurized canisters (~250 psi), dispensed through unheated hoses through a disposable mixing nozzle system, and applied as a froth-like material to substrate. This type of SPF product is typically used for large sealing and small-scale insulation products.

High-Pressure SPF

High-pressure SPF systems are two-component polyurethane foam products. They are typically delivered to the job site in unpressurized drums or totes, and dispensed by a proportioner pump where heat and pressure are added. These chemicals travel through heated hoses to a spray gun where the material is aerosolized during application. This type of SPF product is typically used for larger insulation applications.

Once installed, there is essentially no difference in product performance between low- and high-pressure foams. It should be noted that the main differences between the delivery methods are in capital equipment investment, application rate, and PPE requirements.

Applicators should obtain training from the suppliers of SPF to help assure installation quality and use of all equipment as well as safe handling, use, and disposal of all chemicals used in the process. Spray Polyurethane Foam Alliance (SPFA) also offers additional training and accreditation for high-pressure SPF applicators.

Manufacturer Installation Instructions

In addition to the guidelines above, SPF applicators should follow all manufacturer installation instructions for the product being used. These instructions include product-specific documents such as application instructions, MSDSs, and evaluation reports.

9200 Primary Air Sealing

Primary air sealing measures address larger sources of air leakage or infiltration that often may be diagnosed through visual inspection. Primary sources of air leakage include, but shall not be limited to:

- A) Holes in ceilings, walls, floors, or doors
- B) Missing or broken windows
- C) Missing dampers in chimneys, furnace flues, and exhaust fans
- D) Leaks around window air conditioners.

Infiltration sources of this type tend to reflect direct openings between the interior of the dwelling and the outdoors.

Crawl Spaces—Pre-Work Qualifications			
2.0111.2d	Plumbing and water leaks	Plumbing leaks will be repaired before crawl space upgrade in accordance with the 2012 IRC	Prepare site for upgrade

Crawl Spaces—Providing Access			
2.0701.1a	Access	<p>Crawl space will be accessible in accordance with 2012 IRC R408.4</p> <p>Access to mechanical equipment located in the crawl space will be in accordance with 2012 IRC M1305.1.4</p> <p>Service and maintenance of the crawl space and equipment will be performed without risk of damage to the thermal barrier, air barrier, and ground moisture barrier in accordance with 2012 IRC N1102.2.4 and 2012 IRC AF103.4.10</p>	<p>Provide crawl space access</p> <p>Maintain integrity of the crawl space system</p>
3.1001.1a	Pre-inspection	<p>An inspection will be conducted for mold, water leaks, and water damage before sealing a chase</p> <p>Repairs will be completed before work</p>	Repair moisture-related issues
3.1001.1b	Backing and infill	<p>Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the hole</p> <p>The infill or backing will not bend, sag, or move once installed</p>	<p>Minimize hole size to ensure successful use of sealant</p> <p>Ensure closure is permanent and supports any load (e.g., wind, insulation)</p> <p>Ensure sealant does not fall out</p>
3.1001.1c	Sealant selection	<p>Sealants will be compatible with their intended surfaces</p> <p>Sealants will allow for differential expansion and contraction between dissimilar materials</p> <p>Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction</p>	<p>Select permanent sealant</p> <p>Ensure sealant meets or exceeds the performance characteristics of the surrounding materials</p>
3.1001.1d	High temperature application	<p>Only non-combustible sealant will be used in contact with chimneys, vents, and flues</p> <p>Local codes will be referenced</p>	Prevent a fire hazard

9250 Window and Door Assessment

Windows and doors were once thought to be a major air leakage problem. However, since the widespread use of blower doors and the realization that most homes have gaps in the air barrier, window and door air sealing and replacement have been de-emphasized.

Windows and doors remain very important building elements and their repair or replacement can contribute to energy savings. Window and door measures shall comply with applicable standards listed herein governing lead-safe work practices and SHPO project review guidelines as well as with applicable local codes.

Storm windows shall only be installed on site built dwellings when cost justified with a properly run NEAT audit.

9251 Window and Door Egress

The following egress minimums shall apply to window and door adjustments and repairs:

- A) All functioning egress windows (as defined by local code) shall remain functional.
- B) Non-egress windows may be permanently closed with written authorization from the dwelling owner.

- C) Where there are two or more existing egress doors on the ground floor, at least two doors shall remain functional.
- D) Additional exterior doors may be permanently closed where conditions warrant, with written authorization from the dwelling owner.
- E) At least one egress door on a second or higher floor (where applicable) shall remain functional.

9260 Window Repair

Window repair measures shall comply with the following:

- A) Wherever practicable, windows shall be repaired rather than replaced.
- B) Missing, broken, or severely damaged panes of glass shall be replaced as needed as an air sealing measure and to maintain building durability. Untreated wood shall be primed to ensure durability.
- C) Window glazing, with an appropriate glazing compound and glazing points, shall only be replaced where the existing glazing is deteriorated to the point the panes are in jeopardy of falling out of the sash. Re-glazing wood windows may not be a durable repair without scraping, priming, and painting.
- D) Window stops shall be adjusted if large gaps exist between stop and jamb.
- E) Damaged decorative window glass shall be replaced with standard glass pane. If the client refuses a standard window glass pane, their window glass shall be repaired with clear silicone caulk or a material specifically designed to repair glass.
- F) Ensure that window operates smoothly following stop adjustment.
- G) Window repairs shall not extend beyond those measures required to enable the window or door to close properly.
- H) Improperly functioning, non-egress, jalousie windows located in site-built dwellings may be permanently closed from the exterior using screws and a clear exterior grade adhesive, with written authorization from the dwelling owner.

9261 Window Replacement

Window replacement measures shall be an allowable energy efficiency measures when the replacement can be supported (or cost-justified) by obtaining a measure SIR of 1.0 or greater in the Weatherization Assistant.

Limited exceptions to the measure cost justification requirements may apply to some deteriorated windows. See Section 12000 Incidental Repair for more details.

Under no circumstances shall requests by the client, comfort concerns, aesthetic issues, or statements made by medical professionals, serve as justification for window or door replacements. Window and door replacement measures which are improperly documented, or that are not cost-justified may be disallowed.

- A) New primary windows shall have a National Fenestration Rating Council (NFRC) U-factor of 0.33 or lower, a Solar Heat Gain Coefficient of .22 or lower.
- B) Damaged framing shall be repaired prior to installing the new window.
- C) The cavities around the window frame shall be insulated with closed cell polyethylene foam or sealed with non-expanding foam sealant. If in good condition, the existing casing may be reinstalled.
- D) New casing shall match the existing in design and dimension as closely as possible.
- E) Interior and/or exterior walls damaged when replacing the window shall be repaired with like materials.

- F) New sash sections shall match the existing in design, as closely as possible.
- G) Jamb liners may be installed.

Double Hung Windows			
3.1201.1a	Lead paint assessment	<p>Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise</p> <p>EPA's Renovation, Repair and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards</p>	Protect worker and occupant from potential lead hazards
3.1201.1b	Weather stripping	<p>Existing weather stripping and sash sealant will be removed</p> <p>Surface where the sill meets the sash will be cleaned</p> <p>Seal between the fixed components of the window (e.g., jambs, sill) will be continuous and complete while maintaining the operability of the window</p> <p>Continuous and complete weather stripping will be installed on the bottom of the lower sash where it makes contact with the sill and at the top of the upper sash where it makes contact with the upper part of the window frame</p>	<p>Form a complete seal from the outer edge of the sash to the jamb</p> <p>Maintain operability of the window</p>
3.1201.1c	Sash locks	<p>Locks will be installed so that the rails of the upper and lower sashes are flush and in full contact</p> <p>No gaps will be visible between the two sashes</p> <p>Locks will be installed to achieve compression of the two sashes</p>	Form a secure connection between the two sashes
3.1201.1d	Replacement sills	<p>Beveled sill will be flush with interior wall and sloped to the exterior</p> <p>Seams will be continuously and completely sealed with sealant to the jambs and to the frame</p> <p>Sill will be water-sealed and primed</p>	<p>Form a complete seal from the bottom of the lower sash to the sill</p> <p>Maintain operability of the window</p> <p>Allow for drainage to the exterior</p>
3.1201.1e	Sash replacement	<p>Lower sash will have the same bevel on the bottom rail as the sill</p> <p>Sash will be water-sealed and primed</p>	<p>Ensure sash remains in a fixed position when open or partially open</p> <p>Maintain operability of the window</p>

Single-Unit Window and Fixed Frame with Wood Sash			
3.1201.2a	Lead paint assessment	<p>Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise</p> <p>EPA's RRP Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards</p>	Protect worker and occupant from potential lead hazards
3.1201.2b	Operable windows	All egress windows will be operable as required by local codes	Maintain operability of egress windows
3.1201.2c	Air infiltration	<p>Details that reduce air infiltration will be repaired, replaced, sealed, or installed (e.g., new latch for meeting rail connection, pulley seals, rope caulking for other cracks, interior storm windows)</p> <p>State Energy Conservation Code or local code requirements for air leakage should be met (whichever is more stringent)</p>	Reduce air infiltration
3.1201.2d	Water infiltration	Details that reduce water infiltration will be repaired, replaced, or installed (e.g., replace missing glazing compound on sash, exterior caulking, exterior storm windows)	Reduce water infiltration
3.1201.2e	Occupant education and maintenance	Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain window	Ensure long-term weather tightness
3.1201.1f	Adjust stops	Stops will be adjusted to eliminate visible gaps between the stops and the jamb while maintaining operability of the window	<p>Form a complete seal between the jamb, sash, and stop</p> <p>Maintain operability of the window</p>

3.1201.1g	Replace stops	Stops will be installed to keep the window securely in place Stops will be adjusted to eliminate visible gaps between the stops and the jamb while maintaining operability of the window	Form a complete seal between the jamb, sash, and stop Maintain operability of the window
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Single-Unit Window, Mounted on Rough Opening—Newer House			
3.1202.2a	Lead paint assessment	Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise EPA's RRP Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards	Protect worker and occupant from potential lead hazards
3.1202.2b	Broken glass removal	Window stops and damaged glass will be removed	Safely remove old glass
3.1202.2c	Opening preparation	Opening will be cleaned Glazing tape will be removed or replaced	Prepare opening for new glass
3.1202.2d	New glass installation	Replacement glass will be sized to original width, height, and depth Stops will be replaced or installed Wood stops will be sealed to glass with appropriate sealant Glass will be selected with comparable tint and coating (color and look) Tempered glass will be installed as required by local codes Glazing compound will be added in accordance with manufacturer specifications	Install, seal, and secure new glass in place Allow glazing compound to harden to ensure secure installation

Fixed Frame with Wood Sash—Older House			
3.1203.1a	Lead paint assessment	Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise EPA's RRP Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/ May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards	Protect worker and occupant from potential lead hazards
3.1203.1b	Opening preparation	Interior stops, sashes, parting strips, and pulleys will be removed Opening will be cleaned	Provide a clean opening for replacement window unit
3.1203.1c	Replacement window installation	Replacement window will be installed in accordance with manufacturer specifications, ensuring that the exterior stops are caulked	Ensure replacement window operates properly Ensure replacement window has a weather tight fit
3.1203.1d	Safety	Egress windows and safety glass will be installed in accordance with local codes	Meet all codes when replacing windows
3.1203.1e	Occupant education and maintenance	Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain window	Ensure long-term weather tightness

Single-Unit Window, Mounted on Rough Opening—Newer House			
3.1203.2a	Lead paint assessment	Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise EPA's RRP Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards	Protect worker and occupant from potential lead hazards
3.1203.2b	Opening preparation	Replacement window will be laid out with trim Exterior trim will be removed or exterior siding will be cut back to fit new window with trim Existing window will be removed Window opening will be flashed in accordance with accepted industry standards	Provide a clean and properly flashed opening for replacement window unit
3.1203.2c	Replacement unit preparation	Mounting detail will be determined based on depth of window and location of window liner	Allow for good fit and finish of replacement window

3.1203.2d	Replacement window installation	Replacement windows will be installed in accordance with manufacturer specifications and will be integrated with flashing Gaps between the new window and existing frame will be sealed with low-expanding foam	Ensure replacement window operates properly Ensure replacement window is weather tight
3.1203.2e	Safety	Egress windows and safety glass will be installed in accordance with local codes	Meet all codes when replacing windows
3.1203.2f	Occupant education and maintenance	Occupant will be notified of changes or repairs made and will be educated on how to operate and maintain window	Ensure long-term weather tightness

9270 Door Repair

Door repair measures shall comply with the following:

- A) Wherever practicable, doors shall be repaired rather than replaced.
- B) Door repairs shall not extend beyond those measures required to enable the window or door to close properly.
- C) Permanently closed doors shall not be made functional.

9271 Door Replacement

Door replacement measures shall be allowable only where expenses associated with the replacements can be supported (or cost-justified) based upon maintaining a cumulative SIR attributable to the entire proposed scope of work for the project of 1.0 or greater.

Under no circumstances shall requests by the client, comfort concerns, aesthetic issues, or statements made by medical professionals, serve as justification for window or door replacements. Window and door replacement measures which are improperly documented, or that are not cost-justified may be disallowed. Replacement Door Installation Standards shall comply with the following:

- A) Replacement doors shall be solid core, wood insulated or pre-hung metal insulated doors. Doors shall be Energy Star® rated whenever possible.
- B) Existing locksets may be reinstalled on the new door.
- C) The existing casing may be reinstalled but if new casing is needed, the casing shall match the existing in design and dimension, as closely as possible. The cavities around the door frame shall be insulated with closed cell polyethylene foam or sealed with non-expanding foam sealant.
- D) All door casings shall be caulked.
- E) Doors shall conform to the thickness of the existing jamb.
- F) Solid core doors shall have 3 hinges.

Exterior Doors			
3.1201.3a	Lead paint assessment	Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise EPA's RRP Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/ May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards	Protect worker and occupant from potential lead hazards
3.1201.3b	Door operation and fit	Door will be adjusted to properly fit the jamb and allow for ease of operation (e.g., hinge replacement, re-plane door, door strike adjustment)	Ensure proper operation of the door

3.1201.3c	Air infiltration	Details that reduce air infiltration will be repaired, replaced, sealed, or installed in accordance with State Energy Conservation Code or local code—whichever is more stringent (e.g., weather stripping, door bottoms, trim replacement with foam)	Reduce air infiltration
3.1201.3d	Water infiltration	Details that reduce water infiltration will be repaired, replaced, sealed, or installed (e.g., adjust threshold, caulk jamb to threshold, caulk trim, flashing)	Reduce water infiltration
3.1201.3e	Occupant education and maintenance	Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain weather stripping and caulk around door and trim	Ensure long-term weather tightness

Pocket Door			
3.1201.4a	Backing and infill	Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the hole The infill will not bend, sag, or move once installed	Minimize hole size to ensure successful use of sealant Ensure closure is permanent and supports any load (e.g., wind, insulation) Ensure sealant does not fall out
3.1201.4b	Sealant selection	Sealants will be compatible with their intended surfaces Sealants will allow for differential expansion and contraction between dissimilar materials Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction Sealant will be used in accordance with OSHA/manufacture safety protocol for worker and occupant safety Manufacturer MSDS sheet will be followed for worker safety	Select permanent sealant Ensure sealant meets or exceeds the performance characteristics of the surrounding materials

9300 Secondary Air Sealing

Secondary (also known as discrete) air sealing measures address smaller sources of air leakage that may not be easily visible, but are often still cost effective to correct. Secondary or discrete sources of air leakage include, but shall not be limited to:

- A) Penetrations around chimneys, flues, and exhaust vents
- B) Penetrations around plumbing and heating pipes
- C) Penetrations around electrical service entries and wiring
- D) Gaps between interior wall top plates
- E) Repairing or repositioning door lock sets, strike plates, and stops
- F) Repairing or replacing window sash latches
- G) Loose window glazing (where panes are in jeopardy of falling out only).

Discrete air sealing measures shall be performed only after primary air sealing and duct sealing measures are complete, and only where additional air sealing is determined to be cost effective using the Discrete Air Sealing Cost Effectiveness Chart.

Crawl Space – Providing Access			
2.0701.2a	Sign specifications	A durable, easily seen sign will be installed at all accesses inside of the crawl space (minimum 8 ½" x 11") A minimum expected service life of 10 years will be ensured	Prevent damage to the crawl space after upgrade

2.0701.2b	Sign content	Those entering the crawl space will be cautioned not to damage the air barrier, ground moisture barrier, insulation, and mechanical components specific to the crawl space type Anyone entering the crawl space will be alerted that immediate repairs are needed in case of damage Installer contact information will be included on the sign in case there are questions or needs for repairs	Prevent damage to the crawl space after upgrade Educate anyone entering the crawl space Provide occupants with a way to contact the installer
2.0701.2c	Hazard warning	Language prohibiting storage of hazardous and flammable materials will be provided on site	Prevent storage of hazardous or flammable materials in the crawl space Maintain indoor air quality Prevent a fire hazard

Basements Connected to Crawl Spaces—Sealing and Insulating			
3.1401.1a	Conditioned basements with vented crawl spaces	Crawl space will be separated from the conditioned basement with a continuous air barrier, ground moisture barrier, and thermal boundary	Create separation and define spaces Enable treatment of crawl spaces and basements by referenced specifications Increase house durability and energy efficiency
3.1401.1b	Conditioned basements with closed crawl spaces	Crawl space will be separated from the conditioned basement with a continuous air barrier and ground moisture barrier	Create separation and define spaces Enable treatment of crawl spaces and basements by referenced specifications Increase house durability and energy efficiency
3.1401.1c	Unconditioned basements with vented crawl spaces	Vented crawl space will be separated from the unconditioned basement with a continuous air barrier and ground moisture barrier	Create separation and define spaces Enable treatment of crawl spaces and basements by referenced specifications Increase house durability and energy efficiency
3.1401.1d	Unconditioned basements with closed crawl spaces	Unconditioned basement will be treated as an extension of the closed crawl space	Create separation and define spaces Enable treatment of crawl spaces and basements by referenced specifications Increase house durability and energy efficiency

Crawl Spaces—Sealing Floor Penetrations			
3.1402.1a	Backing and infill	Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration The backing or infill will not bend, sag, or move once installed	Ensure resulting closure is permanent and supports any load (e.g., insulation) Ensure sealant does not fall out
3.1402.1b	Sealant selection	Sealants will be used to fill holes no larger than recommended by manufacturer specifications Sealants will be compatible with their intended surfaces Sealants will allow for differential expansion and contraction between dissimilar materials Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction	Create a permanent seal Ensure sealant meets or exceeds the performance characteristics of the surrounding materials
3.1402.1c	High temperature application	Only non-combustible materials will be used in contact with chimneys, vents, and flues in accordance with authority having jurisdiction	Prevent a fire hazard

Penetrations, Cracks, and Doors Between Garage and House			
3.1501.1a	Penetrations	All lighting fixtures, wiring, plumbing, venting, ducting, and gas piping penetrations will be sealed	Prevent air leakage and pollutant entry

3.1501.1b	Ductwork	All joints and connections in ductwork will be fastened and sealed with UL 181B or 181B-M welds, gaskets, adhesive mastics, or mastic-plus-embedded-fabric systems	Prevent air leakage and pollutant entry
3.1501.1c	Cracks	All cracks in house and garage separation wall will be sealed, including cracks between mud sill, rim joists, subfloors, and bottom of gypsum board, ensuring the air sealing enhances the integrity of the fire resistance construction of that wall All cracks in ceiling surfaces will be sealed	Prevent air leakage and pollutant entry
3.1501.1d	Garage to house door	Weather stripping, door sweep, and threshold will be installed to stop air leakage	Prevent air leakage and pollutant entry
3.1501.1e	Glass	Broken glass panes in doors will be replaced, pointed, and glazed where needed	Prevent air leakage and pollutant entry
3.1501.1f	Carbon monoxide (CO) alarm	CO alarms will be installed in accordance with ASHRAE 62.2, applicable codes and manufacturer specifications	Warn occupants of CO exposure from attached garage
3.1501.1g	Occupant education	Occupant will be educated on need to keep door from garage to house closed and not to warm up vehicles or use any gas engine appliances or grills in the garage, even if the main door is left open	Reduce risk of CO poisoning inside of garage and adjacent rooms

9400 Thermal Bypasses

A thermal bypass refers to areas within a dwelling where unconditioned air can interact with a non-insulated air barrier. Effective identification and treatment of thermal bypasses is critical to achieving energy efficiency and occupant comfort. While measures to address thermal bypasses are performed with the same materials and techniques as air sealing, addressing thermal bypasses may have no impact on air sealing diagnostics. Common examples of thermal bypasses include, but shall not be limited to:

- A) Interior wall cavities
- B) Mechanical chases
- C) Dropped ceilings
- D) Sloped ceilings
- E) Junctures between floor levels
- F) Rim joists
- G) Knee walls
- H) Stairwells adjacent to unconditioned space
- I) Cantilever framing details (overhangs, bay windows, etc.).

Chase Capping			
3.1001.1a	Pre-inspection	An inspection will be conducted for mold, water leaks, and water damage before sealing a chase Repairs will be completed before work	Repair moisture-related issues
3.1001.1b	Backing and infill	Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the hole The infill or backing will not bend, sag, or move once installed	Minimize hole size to ensure successful use of sealant Ensure closure is permanent and supports any load (e.g., wind, insulation)
3.1001.1c	Sealant selection	Sealants will be compatible with their intended surfaces Sealants will allow for differential expansion and contraction between dissimilar materials	Select permanent sealant Ensure sealant meets or exceeds the performance characteristics of the surrounding materials
3.1001.1d	High temperature application	Only non-combustible sealant will be used in contact with chimneys, vents, and flues Local codes will be referenced	Prevent a fire hazard

Interior with Sloped Ceiling			
3.1002.1a	Pre-inspection	An inspection will be conducted for mold, water leaks, and water damage before sealing an open stairwell Repairs will be completed before work begins	Repair moisture-related issues
3.1002.1b	Standard void over stairwell (15-minute fire-rated material; e.g., gypsum lined)	Entire opening will be spanned with rigid material Material will be cut to fit and fastened as required	Prevent air leakage from wall to attic Reduce opening to what can be sealed with sealant Support load as required (e.g., wind, insulation)
3.1002.1c	Non-standard void over stairwell (surfaces around void are not 15-minute fire-rated (e.g., bookcases, chest of drawers), or lined with paneling or other non-fire-rated material)	Material will be used that can be exposed to the interior of the house	Prevent a fire hazard
3.1002.1d	Support	Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation)	Ensure seal stays in place and does not sag
3.1002.1e	Joint seal	Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections	Provide airtight, durable seal that does not move, bend, or sag
3.1002.1f	Perimeter sealing	Air barrier will be extended on all four sides from finished ceiling or existing framing to the new barrier Access will be gained as needed (e.g., pull flooring)	Create a continuous air barrier

Stairwell to Attic—Door at Bottom with No Ceiling Above			
3.1002.2a	Pre-inspection	An inspection will be conducted for mold, water leaks, and water damage before sealing an open stairwell Repairs will be completed before work begins	Repair moisture-related issues
3.1002.2b	Option 1: bring stairwell inside	Materials will be installed in line with the ceiling level with an airtight and operable insulated panel weighing no more than 15 pounds, or a pre-fabricated kit may be used for repeated access OR Airtight seal will be provided between level of new closure or cap and interior ceiling around perimeter Access will be gained as needed (e.g., pull flooring)	Prevent air leakage through stairwell between conditioned space and attic Ensure the insulated panel is lightweight and easy for the occupant to use on an ongoing basis Support insulation Bring the stairwell inside of the thermal boundary Ensure the new closure ties into the existing air barrier on all sides
3.1002.2c	Option 2: keep stairwell outside	An air barrier will be created and insulation material will be continuously installed across all surfaces of stairwell, including weather-stripped and insulated doors OR All cavities between stairs and conditioned space will be insulated and tested to resist air flow (e.g., walls, floors, landings, under stairs) Door will be weatherstripped and insulated OR A combination of the above methods can be used	Prevent air leakage Provide continuous thermal boundary Maximize thermal performance
3.1002.2d	Support	Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation)	Ensure seal stays in place and does not sag
3.1002.2e	Joint seal	Continuous, airtight seals will be provided around seams, cracks, joints, edges, penetrations, and connections	Provide airtight, durable seal that does not move, bend, or sag

3.1002.2f	Perimeter sealing	Air barrier will be extended on all four sides from finished ceiling or from existing framing to the new barrier Access will be gained as needed (e.g., pull flooring)	Create a continuous air barrier
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Stairwell to Attic—Door at Top with Finished Ceiling Above			
3.1002.3a	Pre-inspection	An inspection will be conducted for mold, water leaks, and water damage before sealing an open stairwell Repairs will be completed before work begins	Repair moisture-related issues
3.1002.3b	Option 1: bring stairwell inside	An airtight seal will be provided between level of new closure or cap and interior ceiling around perimeter Access will be gained as needed (e.g., pull flooring) OR An air barrier will be created and insulation material will be continuously installed across all surfaces of stairwell, including weather-stripped and insulated doors OR All cavities between stairs and conditioned space will be insulated and tested to resist air flow (e.g., walls, floors, landings, under stairs) Door will be weatherstripped and insulated OR A combination of the above methods can be used	Reduce air leakage Provide continuous thermal boundary Maximize thermal performance
3.1002.3c	Support	Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation)	Ensure seal stays in place and does not sag
3.1002.3d	Joint seal	Continuous, airtight seals will be provided around seams, cracks, joints, edges, penetrations, and connections	Provide airtight, durable seal that does not move, bend, or sag
3.1002.3e	Perimeter sealing	Air barrier will be extended on all four sides from finished ceiling or existing framing to the new barrier Access will be gained as needed (e.g., pull flooring)	Create a continuous air barrier

New Ceiling Below Original—Old Ceiling Intact or Repairable			
3.1003.1a	Pre-inspection	An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit Repairs will be completed before work begins	Repair moisture-related issues
3.1003.1b	Sealing methods	Entire opening will be spanned with rigid material in line with the ceiling level Material will be cut to fit and fastened as required OR Side of stud bays will be sealed with rigid material from bottom of dropped ceiling to top-plate OR Wall below openings will be dense packed OR Wall below openings will be bridged and sealed with SPF Seals will be used that prevent visible air movement using chemical smoke at 50 pascals of pressure difference	Prevent air leakage from dropped ceiling to attic
3.1003.1c	Support	Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation)	Ensure seal stays in place and does not sag
3.1003.1d	Joint seal	Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections	Provide airtight, durable seal that does not move, bend, or sag
3.1003.1e	Adjacent framing	All remaining gaps will be sealed at the top of the dropped ceiling OR All remaining gaps at the top of the chase will be sealed	Provide airtight framing from one finished side of the dropped ceiling to the other

Ceiling Leaks Not Repairable—No Air Barrier Above			
3.1003.2b	Sealing methods	<p>Ceiling or roof and wall air and thermal barriers will be connected with a rigid airtight connection around the perimeter</p> <p>OR</p> <p>If ceiling will support an air barrier and insulation, a rigid airtight barrier (e.g., gypsum) will be attached to current ceiling either above or below</p> <p>OR</p> <p>Intermediate framing will be used to support air and thermal barrier</p> <p>OR</p> <p>Rigid airtight thermal barrier will be installed at the roof sheathing</p> <p>Seals will be used that prevent visible air movement using chemical smoke at 50 pascals of pressure difference</p>	Prevent air leakage from dropped ceiling to attic
3.1003.2c	Support	Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation)	Ensure seal stays in place and does not sag
3.1003.2d	Joint seal	Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections	Provide airtight, durable seal that does not move, bend, or sag
3.1003.2e	Adjacent framing	<p>All remaining gaps will be sealed at the top of the dropped ceiling</p> <p>OR</p> <p>All remaining gaps at the top of the chase will be sealed</p>	Provide airtight framing from one finished side of the dropped ceiling to the other

Above Closets and Tubs			
3.1003.3a	Pre-inspection	An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit	3.1003.3a
3.1003.3b	Above closets and tubs	<p>Entire opening will be spanned with rigid material in line with the ceiling level</p> <p>Material will be cut to fit and fastened as required</p> <p>OR</p> <p>Side of stud bays will be sealed with rigid material from bottom of dropped ceiling to top-plate</p> <p>OR</p> <p>Wall below openings will be dense packed</p> <p>OR</p> <p>Wall below openings will be bridged and sealed with SPF</p> <p>Seals will be used that prevent visible air movement using chemical smoke at 50 pascals of pressure difference</p>	Prevent air leakage from dropped ceiling to attic
3.1003.3c	Support	Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation)	Ensure seal stays in place and does not sag
3.1003.3d	Joint seal	Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections	Provide airtight, durable seal that does not move, bend, or sag
3.1003.3e	Adjacent framing	All remaining gaps at the top of the dropped ceiling will be sealed	Provide airtight framing from one finished side of the dropped ceiling to the other

Dropped Soffits			
3.1003.6a	Pre-inspection	An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit	3.1003.6a
3.1003.6b	Soffit general	Air flow will be blocked at soffit in locations where access allows	Provide continuous air barrier across soffit openings
3.1003.6c	Option 1: bring soffit inside (seal at top)	Entire opening will be spanned with rigid material in line with the ceiling level Material will be cut to fit and fastened as required	Prevent air leakage from wall to attic Reduce opening to what can be sealed with sealant
3.1003.6d	Option 2: leave soffit outside (seal at bottom or side)	Each stud bay will be spanned with rigid material will be cut to fit and fastened as required OR Backing at each stud bay will be provided and will be sealed OR Side of stud bays will be sealed with rigid material from bottom of soffit to top-plate OR A sealed rigid barrier will be installed at all transitions	Prevent air leakage from wall to soffit Reduce opening to what can be sealed with sealant Ensure soffit is outside of the thermal boundary
3.1003.6e	Soffits containing non-IC rated recessed lights	Insulation will be kept at least 3" away from the top and side of any fixtures If dropped soffit is to be filled with insulation, then a sealed rigid barrier enclosure will be installed to maintain a 3" clearance around the entire fixture Top of rigid barrier enclosure will be sealed with non-insulating rigid material (e.g., gypsum or equivalent perm rating and R-value)	Prevent light fixture from overheating Bring light fixture inside of the air barrier

Cathedralized Attic Air Sealing (Insulation Installed at Roof Deck)			
3.1004.1a	Pre-inspection	An inspection will be conducted for mold, water leaks, and water damage before sealing a cathedralized ceiling	Repair moisture-related issues
3.1004.1b	Backing and infill	Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the open space The infill or backing will not bend, sag, or move once installed	Minimize hole size to ensure successful use of sealant Ensure closure is permanent and supports any load (e.g., wind, insulation) Ensure sealant does not fall out
3.1004.1c	Sealant selection	Sealants will be compatible with their intended surfaces Sealants will allow for differential expansion and contraction between dissimilar materials Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction	Select permanent sealant Ensure sealant meets or exceeds the performance characteristics of the surrounding materials

Tongue and Groove Ceilings			
3.1005.1a	Pre-inspection	An inspection will be conducted for mold, water leaks, and water damage before sealing a tongue and groove ceiling Repairs will be completed before work	Repair moisture-related issues
3.1005.1b	Backing	Backing will be installed behind tongue and groove ceilings	Prevent air leakage and allow for sealants

3.1005.1c	Sealant selection	Sealants will be compatible with their intended surfaces Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction No sealant will be allowed to be visible in the living space	Select permanent sealant Ensure sealant meets or exceeds the performance characteristics of the surrounding materials Ensure ceiling remains aesthetically pleasing
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9500 Air Sealing Window Air Conditioners

Where possible, dwelling occupants shall be encouraged to remove and store window air conditioners when not actively in use. Window air conditioners that remain installed year round shall be treated by air sealing the unit using extruded polystyrene foam board, and one-part interior grade non-expanding spray foam or by constructing a wood frame extension around the unit so an interior storm can be fitted over the unit when not in use. Providing air conditioner covers shall also be allowed.

9600 Air Sealing Near Heat Sources

Special precautions shall be required when air sealing penetrations around chimneys, furnace flues, and heat pipes due to potential fire hazards. In addition to stopping the flow of air around the heat source, insulation blocking shall also be installed per applicable blocking standards for insulation installation to restrict insulation from coming in contact with the heat source. Air sealing measures needed where potential fire hazards exist shall comply with the following minimum standards:

- A) A fire rated medium shall be installed to seal gaps or chases greater than ¼ in. in width around chimneys, flues, or heat pipes.
- B) Gaps of ¼ in. in thickness or less shall be sealed with a caulking agent that meets the Underwriters Laboratory (UL) *T-rating* for fire resistance for the fire rated medium being used.
- C) The fire stopping medium shall consist of aluminum or galvanized steel sheets not less than 26 GA in thickness or a similar noncombustible sheet material not more than ½ in. in thickness.
- D) Combustible sheet goods, including extruded polystyrene foam board and products made of wood, shall not be used for this purpose.
- E) The fire stopping medium shall be sealed to the heat source and the surrounding framing and finish materials with a caulking agent that meets the Underwriters Laboratory (UL) *T-rating* for fire resistance for the medium being used.

10000 Insulation Measures

In order to maintain the greatest energy efficiency possible, a dwelling's air barrier or pressure boundary must remain in continuous contact with the dwelling's thermal barrier or insulation boundary. Therefore, to maximize the benefit of weatherization measures performed insulation shall be installed without voids or gaps, shall not be compressed (thus reducing the effectiveness of the insulation), and shall be protected from moisture and air intrusion. Insulation measures shall be prioritized by first treating the dwelling attic, sidewalls, and then floors.

Where adequate insulation exists in a dwelling pre-weatherization and insulation measures are therefore not specified, related air sealing measures shall still be mandated.

10100 Attic Insulation



Attics in weatherized dwellings shall have an R-value of not less than R-38 to the existing insulation, unless structural limitations such as dwellings with low pitched roofs.

Insulation shall be installed in a manner that eliminates voids and areas of inadequate coverage. R-value requirements withstanding, attic insulation depths shall also be adequate to ensure a uniform, settled coverage depth of not less than 2 in. above the measured height of rafter beams in contact with the ceiling.

Justification shall be required for any instance where the standard minimum attic R-value cannot be installed and such justification (including photographs), shall be maintained in the job file.

10110 Pre-Insulation Attic Inspection

Prior to installing insulation, a thorough inspection of the attic area shall be performed. Inspections shall include a determination of the R-value and integrity of existing insulation, the location of air penetrations or bypasses between the conditioned space and the unconditioned attic, and the suitability of the ceiling structure for receiving insulation. Inspections shall further identify any necessary attic repair work, with an emphasis on work related to roof leaks or other moisture-related issues. Necessary repairs shall be completed prior to proceeding with work.

All mechanical exhaust venting shall be confirmed to terminate outside the roofline or sidewall. No exhaust vents shall terminate in the attic.

Electrical wiring in attic areas shall be inspected to confirm that wiring is not cracked, blistered, or deteriorated and that circuits show no evidence of overloading. Attics containing knob and tube wiring shall be treated in compliance with applicable standards for knob and tube wiring. Electrical junction boxes shall be covered.

2.0104.1a	Worker safety	Follow all worker safety specifications in Global Worker Safety section	Prevent injury Minimize exposure to health and safety hazards
2.0104.1b	Vermiculite	OSHA asbestos abatement protocol 29 CFR 1926.1101 will be followed if vermiculite insulation is present If unsure whether material contains asbestos, a qualified asbestos professional will be contacted to assess the material and to sample and test as needed When working around asbestos-containing material (ACM), the following will not be done: <ul style="list-style-type: none">• Dust, sweep, or vacuum debris• Saw, sand, scrape, or drill holes in the material• Use abrasive pads or brushes to strip materials Attic insulation that looks like vermiculite (as opposed to fiberglass, cellulose, or urethane foams) will not be removed or disturbed	Protect workers from toxic exposure
2.0104.1c	Respiratory protection	All materials will be handled in accordance with manufacturer specifications or Material Safety Data Sheet (MSDS) standards to eliminate hazards associated with incorrect, defective, or improperly used respirator and personal protective equipment (PPE)	Protect workers from toxic exposure
2.0104.1d	Lead paint assessment	Presence of lead based paint in pre-1978 homes will be assumed unless testing confirms otherwise The Environmental Protection Agency (EPA) Renovation, Repair, and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards	Protect worker and occupant from potential lead hazards

10120 Pre-Insulation Attic Preparations

In addition to the standards for performance listed herein, weatherization service providers shall additionally ensure that all materials used to perform attic insulation measures (in particular, extruded polystyrene foam i.e. blue board) comply with applicable local codes.

- A) Duct Sealing — Ductwork located in attics shall be sealed and insulated per applicable standards for duct sealing and insulating prior to installing attic insulation.

- B) Blocking — Blocking shall be installed prior to attic insulation measures to restrict insulation as needed.

Blocking shall be:

- a) formed using a rigid sheet good (such as Thermo-ply)
- b) strong enough to withstand the weight of the insulation installed
- c) installed at a height of 1 in. or greater above the installed depth of the insulation
- d) installed in a manner that provides for a continuous insulation depth to be uniformly achieved above conditioned space.

Blocking shall be provided where a barrier is required to restrict insulation:

- a) from coming in contact with heat sources such as functional masonry chimneys, furnace flues, or heating pipes
- b) from entering the operating mechanisms of devices such as whole house fans
- c) to only those areas located above conditioned space (for example, to partition an attic located above both a conditioned main dwelling and an unconditioned garage)
- d) to provide code compliant access to mechanical equipment located in the attic where required
- e) From clogging a combustion air opening that connects combustion appliance zone to attic.

Blocking for Attic Storage – Blocking shall be installed in floored attics to restrict insulation, allowing for a limited area of attic storage post-weatherization. Where attic storage is installed by the Weatherization Service Provider, such storage areas shall not be larger than 32 ft² in total area and shall be accessible directly from the attic access. Insulation shall be installed beneath any such floored storage area per applicable standards listed herein.

Blocking for Heating Exhaust Venting – Blocking installed specifically to restrict insulation from coming in contact with potential heat sources including functional masonry chimneys, furnace flues, and heating pipes shall be formed from a galvanized steel or aluminum sheet good not less than 26 GA in thickness or a similar noncombustible sheet good shall be required. Aluminum flashing shall not be used for this purpose. Blocking shall be affixed to the dwelling structure to ensure a minimum 3 in. clearance is maintained on all sides between blocking and heat sources and, where applicable, shall be notched to avoid contact with electrical wiring.

Blocking for Non-Heat Producing Mechanical Devices – Functional non-heat producing mechanical devices located in attics, including whole house attic fans, shall be blocked and covered providing a sturdy non-permanent, but still airtight, housing around the device to restrict insulation from coming in contact with the operating mechanisms. The cover shall be removable such that the device may be uncovered and operated seasonally without disturbing the adjacent insulation.

Heat Producing Mechanical Devices – Insulation may be installed directly over heat producing mechanical devices that are airtight and rated IC (Insulation Contact) only. No insulation, including fire rated insulation, shall be installed over non-airtight and/or non-IC rated devices.

Where non-IC rated recessed lighting fixtures must be addressed in order to provide uniform insulation coverage, replacement of the existing non-IC rated fixtures with comparable, airtight, IC rated fixtures shall be the only allowable treatment measure and shall be performed wherever cost-effective. After-market treatments intended to address noncompliant recessed lighting fixtures including, but not limited to,

prefabricated flame resistant cover kits and apparatuses fashioned by weatherization personnel shall not be allowed.

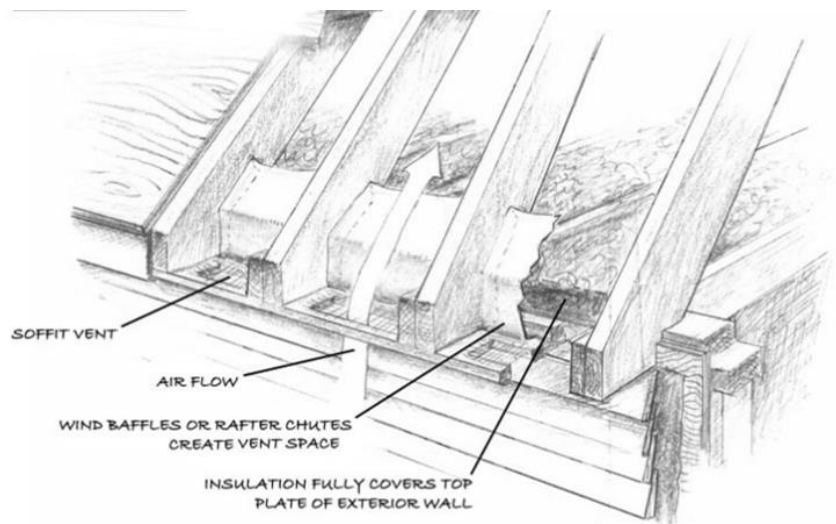
4.1001.1a	Air barrier system	The non-IC rated light fixture will be replaced with an airtight and IC-rated fixture	Prevent a fire hazard Prevent air leakage through fixture
4.1001.1d	Sealants and weather stripping	Caulk, mastic, or foam will be used on all edges, gaps, cracks, holes, and penetrations of closure material only	To prevent air leakage, completely adhere the sealant to all surfaces to be sealed
4.1001.3a	Verify attic prep	Holes, penetrations, and bypasses will be sealed Dams will be fixed in places that maintain required clearance	Prevent air leakage Ensure insulation dams maintain clearance
4.1001.3b	Required clearance	A rigid dam having a height greater than the insulation to be installed will be constructed to ensure a 3" clearance between combustion flue vent and dam Chimney vents will have an airspace clearance to combustibles in accordance with 2012 IRC M1801.3.4	Ensure dam material does not bend, move, or sag Prevent a fire hazard
4.1001.3c	Safety	Insulation will not be allowed between a heat-generating appliance and a dam unless material is rated for contact with heat generating sources	Prevent a fire hazard
4.1001.3d	Occupant education	Documentation of material and R-value will be provided to occupant	Provide occupant with documentation of installation

Whole house attic fans			
4.1006.3a	Installation	Sides of fan insulation box assembly will be insulated to the same R-value as adjoining insulated assembly	Insulate to prescribed R-value
4.1006.3b	Air sealing	Fan insulation box frame will be continuously weatherstripped to ensure a tight fit Fan insulation box will be constructed at a depth to protect the fan housing and motor from insulation	Prevent air leakage
4.1006.3c	Attachment	Non-compressible insulation will be permanently attached in contact with fan insulation box Appropriate adhesive or mechanical fastener will be used	Ensure continuous alignment with air barrier
4.1006.3d	Durability	Material integrity will meet a minimum expected service life of 20 years	Ensure a minimum expected service life
4.1006.3e	Occupant education	Purpose of insulation will be communicated to occupant	Educate occupant on how to use the whole-house fan to ensure integrity of the fan insulated assembly throughout service life

Skylights			
4.1088.3a	Sealing	Holes and penetrations will be sealed Bypasses will be blocked and sealed	Prevent air leakage
4.1088.3b	Installation	Insulation will be installed in accordance with manufacturer specifications and will be in full contact with all sides of existing cavity without gaps, voids, compressions, misalignments, or wind intrusions Insulation will be installed to prescribed R-value	Insulate to prescribed R-value
4.1088.3c	Occupant education	Documentation of material and R-value will be provided to occupant	Provide occupant with documentation of installation

Wind Baffles — Free circulation of air through soffit vents shall be maintained at all times through the use of rafter chutes or wind baffles designed specifically to restrict insulation moving. Where installed, baffles shall be continuous from the soffit vent to roof decking, shall be the appropriate width to align with the roof framing, and shall be secured to avoid movement. Rafter vents that do not fasten to the top plate shall not be allowed.

Wind Baffle/Rafter Chute Diagram



4.1001.4a	Installation	<p>If soffit venting or eave venting is present, baffles will be mechanically fastened to block wind entry into insulation or to prevent insulation from blowing back into the attic</p> <p>If soffit venting or eave venting is present, baffles will be installed to maintain clearance between the roof deck and baffle in accordance with manufacturer specifications</p> <p>Installation will allow for the highest possible R-value above the top plate of the exterior wall</p>	<p>Ensure insulation R-value is not reduced</p> <p>Maintain attic ventilation</p>
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Depth Markers — Depth markers shall be affixed to framing members throughout the attic space in a manner that ensures that a clear and accurate representation of the uniformly installed insulation depth is provided. Depth markers shall be located every 6-10 ft. and shall face the attic access where possible.

Junction Flags—Junction flags shall be installed to identify the location of all electrical junction boxes and lighting fixtures prior to insulation installation.

10130 General Attic Insulation Guidelines

Bag Counts—Calculations based on a count of the number of bags used, as per manufacturer specifications, shall be the preferred method for determining the proper quantity and density of material that shall be installed to achieve a specified R-value.

Material Selection — Insulation products selected shall be appropriate for the conditions present in the dwelling and shall be installed per manufacturer specifications. Where a dwelling structure may not support the weight of a heavier insulation material such as blown cellulose insulation, a lighter weight blown insulation material shall be installed. Where existing insulation may be compressed beneath the weight of heavier blown cellulose insulation resulting in a reduction in the effective R-value of the batts, a lighter weight blown insulation material shall be installed.

Floored Attic Installation — Where insulation is installed in a floored attic using the drill-and-blow method, holes shall be properly plugged, secured with adhesive, and sealed. Floor planks may also be removed to allow for access to blow cavities, and then reinstalled.

Accessible Floors—Loose Fill Installation			
4.1005.2a	Preparation	<p>Subfloor or drywall will be removed to access cavities as necessary, including inaccessible knee-wall attic floor spaces</p> <p>Insulation will be adequately marked for depth a minimum of every 300 square feet of attic area, with measurement beginning at the air barrier</p> <p>All electrical boxes will be flagged to be seen above the level of the insulation</p> <p>Open electrical junctions will have covers installed</p> <p>Insulation dams and enclosures will be installed as required</p>	<p>Access the workspace</p> <p>Verify uniformity of insulation material</p> <p>Provide location of electrical boxes for future servicing</p> <p>Prevent an electrical hazard</p>
4.1005.2b	Air barrier	<p>Existence of air barrier material in line with the knee walls will be installed or verified when dense packing</p> <p>Air barrier material will not bend, sag, or move once dense packed</p>	Hold dense pack in place
4.1005.2c	Installation	All insulation will be installed to the depth indicated on the manufacturer coverage chart for desired R-value	<p>Reduce heating and air conditioning costs</p> <p>Improve comfort</p> <p>Minimize noise</p>
4.1005.2d	Onsite documentation	<p>A signed and dated attic card will be provided that includes:</p> <ul style="list-style-type: none"> • Insulation type • Installed thickness and settled thickness • Coverage area • R-value • Number of bags installed in accordance with manufacturer specifications 	<p>Document job completion to contract specifications</p> <p>Confirm amount of insulation installed in attic</p> <p>Ensure ability to match bags required for total area completed</p>

Insulation Certificates—Insulation certificates containing the following information shall be installed at or near the attic access in every dwelling weatherized:

- A) insulation type
- B) density specifications
- C) stated R-value
- D) bag count installed (#)
- E) anticipated settled depth
- F) installation date
- G) business name of the install firm
- H) MSDS information.

10140 Attic Accesses

Access to the attic shall be provided in all dwellings weatherized for purposes of post-weatherization inspections and potential future needs of the dwelling occupants. Existing attic accesses shall comply with applicable standards or installation of a new access shall be required.

Compliant interior attic accesses shall:

- A) Have existing dimensions of not less than 16 in. by 24 in., or where installed have dimensions of not less than 16 in. by 30 in.

- B) Be located in area of the dwelling that allows for entry and exit from the access without disturbing major appliances or furnishings (for example, hallways or unobstructed utility rooms)
- C) Have an air sealed weather-stripped (self-adhesive permissible) cover, insulated to not less than a value the surrounding insulation, which may be easily opened by dwelling occupants
- D) Be strong enough to support the weight of an average sized adult entering or exiting the attic
- E) Where required, insulation blocking around attic accesses shall be installed per applicable blocking standards
- F) Must include a finish material (for example, 2-3 in. primed trim molding made from medium density fiberboard) which provides a workmanship-like appearance.

Prefabricated attic access kits or treatments which meet the minimum standards listed herein (including Energy Guardian kits) shall be allowed. Zippered attic hatch tents shall be not be allowed. Attic accesses located in unconditioned space shall not be insulated or weather-stripped.

Pull-Down Stairs			
4.1006.1a	Installation	Hatches will be insulated with non-compressible insulation and the measure will include a protective barrier or baffle Pull-down stair assembly will be insulated to the same R-value as the adjoining insulated assembly Pull-down stair rough opening will be surrounded with a durable dam that is higher than the level of the attic floor insulation	Achieve uniform R-value Prevent loose insulation from entering the living area
4.1006.1b	Sealing	Entire pull-down stair assembly will be covered with an airtight and removable/openable enclosure inside the attic space Pull-down stair frame will be caulked, gasketed, weatherstripped, or otherwise sealed with an air barrier material, suitable film, or solid material that allows attic door operation	Prevent air leakage
4.1006.1c	Durability	Completed measure will meet a minimum expected service life of 20 years	Ensure a minimum expected service life
4.1006.1d	Occupant education	The purpose of the entire measure (insulation, air seal, protective barrier, proper attic stair operation) will be communicated to occupant	Educate occupant on how to use the hatch to ensure integrity of insulated and sealed assembly throughout service life

Access Doors and Hatches			
4.1006.2a	Installation	Access hatches will be insulated with non-compressible insulation to the same R-value as adjoining insulated assembly Attic hatches rough opening will be surrounded with a durable protective baffle that is higher than the level of the surrounding attic floor insulation	Achieve uniform R-value on the attic door or hatch Achieve uniform R-value on the attic floor Prevent loose attic floor insulation from entering the living area
4.1006.2b	Sealing	Access hatch frames will be sealed using caulk, gasket, weatherstrip, or otherwise sealed with an air barrier material, suitable film, or solid material Options will include installing a latch or lock or frictionally engaged components of a pre-fabricated unit above the opening that do not require a latch The measure must include a protective baffle or insulation	Prevent air leakage
4.1006.2c	Attachment	Insulation will be permanently attached and in complete contact with the air barrier	Insulate to prescribed R-value
4.1006.2d	Durability	Completed measure will meet a minimum expected service life of 20 years	Ensure a minimum expected service life
4.1006.2e	Occupant education	Purpose of insulation and proper hatch operation will be communicated to occupant	Educate occupant on how to use the hatch to ensure integrity of insulated and sealed assembly throughout service life

10150 Vaulted or Sloped Ceiling/Roof Cavities

Vaulted ceilings, sloped ceilings, or roof cavities shall be insulated to a value of no less than R-19, whenever possible. Where it is not possible to insulate to R-19, the limiting factor(s) shall be documented in the job file. A backing consisting of a rigid sheet good such as lauan, Thermo-ply, or Thermax shall be installed to hold insulation in the roof cavity. Extruded polystyrene foam shall not be used. Where fiberglass batt insulation is installed, the attached vapor retarder shall always face conditioned space. Where blown fiberglass insulation is installed, the material shall be filled to capacity in the vaulted or sloped ceiling or roof cavities with **no** soffits. An air space must be maintained in cavities with soffits.

Pitched/Vaulted/Cathedralized Ceilings—Loose Fill Over			
4.1003.1a	Ventilation	Venting will be continuous, if applicable	Ensure capacity to increase R-value while not altering ventilation
4.1003.1b	Lighting	Existence of rated insulation contact can lights, which allow for insulation encapsulation, will be verified Non-insulation contact rated can lights will not be insulated	Prevent a fire hazard
4.1003.1c	Installation	When using cellulose, stabilized product is preferred when available On roof pitches less than 6/12, loose fill cellulose can be used; on roof pitches greater than 6/12, install Insulweb baffles of the same height as the insulation every 6' across slope to prevent the loose fill insulation from sliding downward, or dense pack cellulose above Insulweb stapled to the bottom (underside) of the rafters Loose fill fiberglass will only be used on a slope less than or equal to a 6/12 pitch or the slope application approved by the manufacturer, whichever is less (dense packed fiberglass at slopes greater than 6/12 may be used) Roof cavities will be insulated with loose fill according to manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions Insulation will be installed to prescribed R-value	Ensure appropriate material and application Insulate to prescribed R-value
4.1003.1d	Occupant education	Documentation of material and R-value will be provided to occupant	Provide occupant with documentation of installation

Cape Cod Side Attic Roof—Dense Pack Installation			
4.1003.4a	Vapor barrier removal	Vapor barriers will be removed from existing attic floor	Ensure the new conditioned space is coupled with the house
4.1003.4b	Netting, fabric, rigid sheathing	When using netting or fabric, staples will be placed every 1 ½" on center, or in accordance with manufacturer specifications, whichever is more stringent Netting or fabric will meet local fire codes Rigid materials will close the cavity	Secure insulation
4.1003.4c	Installation	Roof cavities will be dense packed with loose fill insulation in accordance with manufacturer density specifications Insulation will be installed to prescribed R-value	Insulate to prescribed R-value
4.1003.4d	Onsite documentation	Documentation will be posted as required by federal specification 16 CFR 460	Post documentation onsite to allow verification
4.1003.4e	Occupant education	Documentation of material and R-value will be provided to occupants	Provide occupant with documentation of installation

10160 Knee Wall Accesses and Insulation

Access to knee wall areas shall be provided in all dwellings weatherized for purposes of post-weatherization inspections and potential future needs of the dwelling occupants. Existing knee wall accesses shall comply with the standards below or installation of an additional access shall be required. Interior knee wall accesses shall be:

- A) No less than the width of the knee wall stud cavity by 24 in. in height;

- B) Air sealed, weather-stripped, and insulated to no less than R-15;
- C) Open joists under kneewalls shall be air sealed with blocking behind the bottom plate, and not flush;
- D) Secured with no less than one latch to ensure air tightness.

Adjacent knee wall cavities shall be air sealed and insulated to no less than R-15 using fiberglass batt or blown cellulose insulation installed at a density of 3.5- 4.5 lb/ft³. A backing consisting of a rigid sheet good such as luan, Thermo-ply, or Thermax shall be installed to hold insulation in the wall cavity. Extruded polystyrene foam shall not be used.

Where it is not feasible to provide permanent access to knee wall areas, the attic and/or knee wall area shall be inspected by an auditor/final inspector prior to access to the area being sealed. Measures installed in the knee wall area shall, for documentation purposes, be photographed prior to the access being sealed and justification of the need to seal the access, as well as photographic documentation of the measure performed on the interior of the knee wall space, shall be maintained in the job file. Prefabricated knee wall access kits or treatments which meet the minimum standards above shall be allowed.

4.1003.1a	Ventilation	Venting will be continuous, if applicable	Ensure capacity to increase R-value while not altering ventilation
4.1003.1b	Lighting	Existence of rated insulation contact can lights, which allow for insulation encapsulation, will be verified Non-insulation contact rated can lights will not be insulated	Prevent a fire hazard
4.1003.1c	Installation	When using cellulose, stabilized product is preferred when available On roof pitches less than 6/12, loose fill cellulose can be used; on roof pitches greater than 6/12, install Insulweb baffles of the same height as the insulation every 6' across slope to prevent the loose fill insulation from sliding downward, or dense pack cellulose above Insulweb stapled to the bottom (underside) of the rafters Loose fill fiberglass will only be used on a slope less than or equal to a 6/12 pitch or the slope application approved by the manufacturer, whichever is less (dense packed fiberglass at slopes greater than 6/12 may be used) Roof cavities will be insulated with loose fill according to manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions Insulation will be installed to prescribed R-value	Ensure appropriate material and application Insulate to prescribed R-value
4.1003.1d	Occupant education	Documentation of material and R-value will be provided to occupant	Provide occupant with documentation of installation

4.1003.4a	Vapor barrier removal	Vapor barriers will be removed from existing attic floor	Ensure the new conditioned space is coupled with the house
4.1003.4b	Netting, fabric, rigid sheathing	When using netting or fabric, staples will be placed every 1 ½" on center, or in accordance with manufacturer specifications, whichever is more stringent Netting or fabric will meet local fire codes Rigid materials will close the cavity	Secure insulation
4.1003.4c	Installation	Roof cavities will be dense packed with loose fill insulation in accordance with manufacturer density specifications Insulation will be installed to prescribed R-value	Insulate to prescribed R-value
4.1003.4d	Onsite documentatio	Documentation will be posted as required by federal specification 16 CFR 460	Post documentation onsite to allow verification
4.1003.4e	Occupant education	Documentation of material and R-value will be provided to occupants	Provide occupant with documentation of installation

10200 Sidewall Insulation

Dense-packed sidewall insulation shall be installed where non-insulated wall sections exist, including walls that separate conditioned space from unconditioned space such as garages or unheated porches. Where incomplete sidewall insulation exists, insulation shall be added to provide complete sidewall coverage.

Applicable standards for local code compliance shall apply to the installation of sidewall insulation. Applicable standards for lead-safe work practices shall additionally apply to sidewall work on dwellings built in 1978 or before. Applicable standards for SHPO approval shall apply to dwellings 45 years or older where sidewall insulation is required.

Exceptions to the requirement of installing sidewall insulation may include:

- A) No wall cavity
- B) Presence of knob and tube wiring certified as being unsafe, where there are insufficient resources available to replace the wiring
- C) Interior and/or exterior walls too weak to withstand pressure of sidewall insulation
- D) Existing wall insulation
- E) Refusal of the measure by the dwelling owner.

Justification for any omission of sidewall insulation shall be well documented. Exceptions shall be allowed only where reasonable justification exists and the course of action selected is clearly evidenced. The presence of brick as an exterior cladding **shall not** constitute reasonable justification not to install sidewall insulation. Weatherization service providers shall be responsible for ensuring adequate justification and documentation for such exceptions is maintained in the job file.

10210 Pre-Insulation Sidewall Inspection

Both the interior and exterior of all dwellings shall be inspected prior to installation of sidewall insulation. Repairs required as a result of the inspection shall be performed prior to insulation work commencing. All deficiency conditions observed and the manner in which each was resolved shall be documented in the job file.

Interior Inspection — At minimum, interior wall inspections shall identify and document:

- A) presence of existing sidewall insulation, as evidenced by manually testing at least three stud bays
- B) any areas of the interior wall surface which are weak or not securely fastened
- C) location of all exterior wall-mounted switches and outlets, chases, utility runs, duct runs, wall heaters, vent fan penetrations, etc.
- D) any interior soffit areas, pocket doors, or other structural details that may need preparation prior to insulating
- E) critical framing junctures which impact the ability of the wall to contain high-density insulation.

Exterior Inspection — At minimum, exterior wall inspections shall identify and document:

- A) type(s) of siding material present, especially siding material that may contain asbestos and/or lead-based paint

- B) best drilling strategy, including whether siding may be lifted or temporarily removed to drill subsiding or sheathing
- C) severely deteriorated window or door components or damaged, rotted, or deteriorated siding which requires replacement to ensure the integrity of the insulation
- D) the source of any moisture in wall cavities
- E) structural additions and critical junctures which impact the ability of the wall to contain high-density insulation
- F) any obstructions near the perimeter of the dwelling which must be removed to provide access to the wall cavity during installation.

10220 Pre-Insulation Sidewall Preparation

- A) Air Sealing — Walls shall be air sealed prior to installation of sidewall insulation, including the sealing of top and bottom wall plates, particularly in dwellings with balloon framing.

Walls Open to Attic—Balloon Framing and Double Walls			
3.1001.3a	Pre-inspection	An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit Repairs will be completed before work begins	Repair moisture-related issues
3.1001.3b	Sealing methods	Entire opening will be spanned with rigid material in line with the ceiling level Material will be cut to fit and fastened as required OR Wall below openings will be dense packed OR Wall below openings will be bridged and sealed with spray polyurethane foam (SPF) Sealants will be used that prevent visible air movement using chemical smoke at 50 pascals of pressure difference	Prevent air leakage from wall cavity to attic
3.1001.3c	Support	Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation)	Ensure seal stays in place and does not sag
3.1001.3d	Joint seal	Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections	Provide airtight, durable seal that does not move, bend, or sag
3.1001.3e	Adjacent framing	All remaining gaps at the top of the opening will be sealed OR All remaining gaps at the top of the chase will be sealed	Ensure airtight seal from one finished side of the wall assembly to the other

Open Walls			
4.1102.1a	Sealing	Holes and penetrations will be sealed Bypasses will be blocked and sealed	Prevent air leakage
4.1102.1b	Installation	Insulation will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions Insulation will be installed to prescribed R-value	Insulate to prescribed R-value
4.1102.1c	Pre-drywall	Verification of complete installation without gaps, voids, compressions, misalignments, or wind intrusions will be provided	Install insulation correctly
4.1102.1d	Occupant education	Documentation of material and R-value will be provided to occupant	Provide occupant with documentation of installation

Enclosed Walls

4.1102.1a	Sealing	Holes and penetrations will be sealed Bypasses will be blocked and sealed	Prevent air leakage
4.1102.1b	Installation	Insulation will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions Insulation will be installed to prescribed R-value	Insulate to prescribed R-value
4.1102.1c	Pre-drywall	Verification of complete installation without gaps, voids, compressions, misalignments, or wind intrusions will be provided	Install insulation correctly
4.1102.1d	Occupant education	Documentation of material and R-value will be provided to occupant	Provide occupant with documentation of installation

Additional Exterior Wall Cavities			
4.1103.2a	Location of cavities	Details remaining in or between completed wall sections will be located and accessed	Ensure the last gaps and framing edges in the thermal boundary, roof-wall joints, floor-wall joints, etc., are found and finished
4.1103.2b	Sealing	Backing will be provided and all newly uncovered openings will be sealed with air barriers, foam, or mastic, maintaining all required clearances	Ensure the air barrier is connected across all accessible house elements
4.1103.2c	Dense packing	Using fill tube, 100% of each cavity will be filled to a consistent density: <ul style="list-style-type: none"> Cellulose insulation used in an enclosed cavity will be installed at 3.5 pounds per cubic foot or greater density Blown fiberglass, mineral fiber, or rock and slag wool used in an enclosed cavity will be installed at or above the manufacturer recommended density to limit airflow that corresponds to an air permeance value of 3.5 cfm/sq. ft. at 50 pascals, as measured using BPI-102 "Standard for Air Resistance of Thermal Insulation Used in Retrofit Cavity Applications—Material Specification" or ASTM C 522, E 283, or E 2178; the number of bags installed will be confirmed and will match the number required on the coverage chart Insulation will be verified to prevent visible air movement using chemical smoke at 50 pascals of pressure difference	Eliminate voids and settling Minimize framing cavity air flows
4.1103.2d	Quality assurance	Completed wall sections will be viewed using infrared camera with blower door operating Any voids or low density areas will be drilled and re-packed	Establish air barrier and thermal boundary Confirm no voids or hidden air flows remain
4.1103.2e	Close holes	Installation holes will be plugged as follows: <ul style="list-style-type: none"> Exterior holes will be weather barrier patched Interior holes will be coated and patched to match original interior surface All construction debris and dust will be collected and removed	Ensure house is returned to watertight and clean condition

B) Blocking — Construction details that allow insulation to escape from sidewall cavities (such as balloon framed walls) shall be blocked in a manner that effectively retains the insulation.

C) Plugging, Patching, and Finishing

Exterior

- Where exterior lap siding is removed and holes drilled in the sheathing and/or subsiding for the installation of insulation, holes in the exterior subsiding may be patched using wood plugs, plastic plugs, or shall be sealed using construction adhesive.
- Where holes are drilled through exterior siding, plugs installed and any wood or siding replaced shall be compatible with the exposed surface that has been drilled and shall be sealed and primed.

Interior

- a) Where possible, holes drilled during interior applications shall be drilled in a manner such that they may be covered using primed medium-density fiberboard chair rail molding of not less than 4 in. in width. Compatible plugs shall not be required in such applications.
- b) Where holes must be drilled in interior wall surfaces where covering them with molding is impractical, plugs installed shall consist of a material which is compatible to the existing interior wall surface. Compatible plugs shall be sealed and primed as applicable depending on the material type to achieve a workmanship-like finish to the wall surface post-installation.

10230 General Sidewall Insulation Guidelines

Sidewall insulation shall be installed according to the manufacturer recommendations for density and in a manner that does not allow the material to settle. Cellulose is the preferred material for dense-pack sidewall insulation. When insulating sidewalls with blown cellulose, it shall be installed at a density of 3.5 – 4.5 lbs/ft³ using the tubing method. Blown shall not be installed against chimneys or certain electrical fixtures. Where blown fiberglass is required, it shall be installed at a density of 1.6 lb/ft³.

The quality and quantity of sidewall insulation installed shall be assessed post-installation using an infrared camera and by using the calculation method based on dwelling square footage and cavity depth. Additional inspection techniques may be used in conjunction with prior methods, including inspection of core samples or using a z shaped test wire.

Exterior Wall Dense Packing			
4.1101.1a	Preparation	<p>Lead and asbestos safety procedures will be followed</p> <p>Cavities will be free of hazards, intact, and able to support dense pack pressures</p> <p>Drilling hazards (e.g., wiring, venting, fuel piping) will be located</p> <p>Blocking will be installed around:</p> <ul style="list-style-type: none"> • All openings to inside crawl space and basement for fibrous material • High temperature fire-rated materials • Wiring and electrical hazards • Heat sources <p>Access to exterior wall cavities will be gained, sheathing will be drilled as needed and probed to locate each cavity, wall studs, and blockers</p> <p>Interior will be masked and dust controlled during drilling when accessing from interior</p> <p>Electricity supply will be confirmed and will support blowing machine power demand</p> <p>Blowing machine pressure test will be performed with air on full, feed off, agitator running, and gate closed</p> <p>Hose outlet pressure will be at least 80 IWC or 2.9 psi for cellulose insulation; for other types of dense pack insulation, check manufacturer specification for blowing machine set up</p>	<p>Prevent damage to house</p> <p>Provide a clean work space</p> <p>Provide thorough access to allow 100% coverage</p> <p>Ensure proper equipment and process results in consistent density</p> <p>Prevent settling and retard air flow through cavities</p> <p>Protect worker and occupant health</p>
4.1101.1b	Exterior dense pack	<p>Using fill tube, 100% of each cavity will be filled to a consistent density:</p> <ul style="list-style-type: none"> • Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot <p>The number of bags installed will be confirmed and will match the number required on the coverage chart</p> <p>Insulation density will be verified by bag count, core sampling, or infrared camera with the blower door at 50 pascals to prevent visible air movement using chemical smoke at 50 pascals of pressure difference</p>	<p>Eliminate voids and settling</p> <p>Minimize framing cavity air flows</p>

10300 Floor Insulation

Where floor insulation measures are performed, installed insulation materials shall have a rated R-value of not less than R-19. In dwellings in which structural limitations exist that do not allow for the installation of R-19, the insulation shall be installed to a value of not less than R-11. Where existing floor insulation is present, insulation shall be installed only to correct damaged areas. Existing properly installed insulation that is rated as R-11 shall not be removed to install R-19. Dwellings in coastal areas that have a heat pump as their primary heat source shall not have floor insulation installed without a site specific, computerized audit being performed. The coastal counties are as follows: Beaufort, Bertie, Brunswick, Chowan, Camden, Carteret, Craven Currituck, Dare, Gates, Hyde, New Hanover, Onslow, Pamlico, Pender, Pasquotank, Perquimans, Tyrrell, and Washington.

Exceptions limiting the performance of floor insulation measures shall include:

- A) Presence of knob and tube wiring certified as being unsafe, where there are insufficient resources available to replace the wiring
- B) Crawl space clearances and joist depths adequate to allow for installation of R-19 insulation over 60% or more of the total floor area shall be considered sufficient to achieve the minimum cost-effective R-value rating of R-11. Where such conditions exist, floor insulation measures shall not be installed.

Weatherization service providers shall be responsible for ensuring that adequate justification and documentation for any exception is maintained in the job file.

10310 Pre-Insulation Floor Inspection

All dwellings' crawl spaces and floors shall be inspected prior to installation of floor insulation. All repairs required as a result of the inspection shall be performed prior to insulation work commencing.

At minimum, crawl space and floor inspections shall identify and document:

- A) Presence, condition, and R-value of existing floor insulation
- B) Presence and source of any existing or potential moisture problems
- C) Decayed, broken, or damaged structural components, critical framing junctures, and/or any areas of the floor which are weak
- D) Location of all heat sources, chases and floor penetrations, utility runs, ductwork, etc.
- E) Presence of large obstructions, and/or personal property that must be removed in order for the floors to be insulated effectively.

All deficiency conditions observed and the manner in which each was resolved shall be documented in the job file.

10320 Pre-Insulation Floor Preparations

- A) Floors shall be air sealed prior to installing insulation as per applicable standards for air sealing listed here. Emphasis shall be placed on air sealing penetrations beneath bathtubs and open bottom plates.

- B) Where floor insulation is installed in an enclosed crawl space, a properly functioning crawl space door including a clasp closure shall be required.
- C) Where a combustion appliance or flue is present, insulation and other combustible materials shall be kept at a minimum clearance of 6 in. from any such heat source.

Crawl Spaces—Pre-Work Qualifications			
2.0111.2g	Appliance and heating, ventilation, and air conditioning (HVAC) system repairs and change outs	Crawl space upgrades (e.g., sealing and insulation) are to be undertaken after appliance and HVAC system work has been completed and inspected in accordance with the 2012 IRC and/or the authority having jurisdiction	Prepare site for upgrade

10330 General Floor Insulation Guidelines

- A) Insulation with a value of R-19 shall be installed unless prohibited by the depth of the floor joists. In no instance shall insulation have a value of less than R-11.
- B) Insulation shall be installed without voids or gaps and shall fit tightly around cross bracing, framing members, and other obstructions and fastened securely in place with wire fasteners, nylon mesh, or other appropriate fastener. Friction fitting or stapling floor insulation shall not be permitted.
- C) Insulation shall be installed in a manner which ensures continuous contact with the underside of the subfloor and with the rim or band joists.
- D) Fiberglass insulation with an attached vapor retarder shall be installed with the retarder facing upward toward the conditioned space.

Standard Floor System—Batt Installation			
4.1301.1a	Sealing	Sealing the floor system will be completed before insulating	Ensure airtight envelope Prevent leakage
4.1301.1b	Installation	Insulation will be installed in contact with subfloor without gaps, voids, compressions, misalignments, or wind intrusions If kraft-faced batts are used, they will be installed with kraft facing to subfloor Insulation will be installed to prescribed R-value	Insulate to prescribed R-value
4.1301.1c	Securing batts	Batts will be secured with physical fasteners	Ensure insulation remains in contact with subfloor
4.1301.1d	Occupant education	Documentation of material and R-value will be provided to occupant	Provide occupant with documentation of installation

Cantilevered floor			
4.1301.5a	Air barrier	Air barrier will be installed between joists and sealed Air barrier will be placed to the most interior edge of the top plate of the wall below	Separate cantilevered floor from conditioned floor space Allow for insulation
4.1301.5b	Installation	Air barrier will be insulated between joist from top plate of the wall below to subfloor above Cantilevered subfloor will be insulated in complete contact with the floor without gaps, voids, compressions, misalignments, or wind intrusions If kraft-faced batts are used, they will be installed with kraft facing to the air barrier Insulation will be installed to prescribed R-value	Insulate to prescribed R-value
4.1301.5c	Attachment	Batts will be secured with physical fasteners	Ensure insulation remains in contact with subfloor and air barrier
4.1301.5d	Exterior soffit	Exterior soffit material will be installed and sealed	Cover and protect insulation

4.1301.5e	Occupant education	Documentation of material and R-value will be provided to occupant	Provide occupant with documentation of installation
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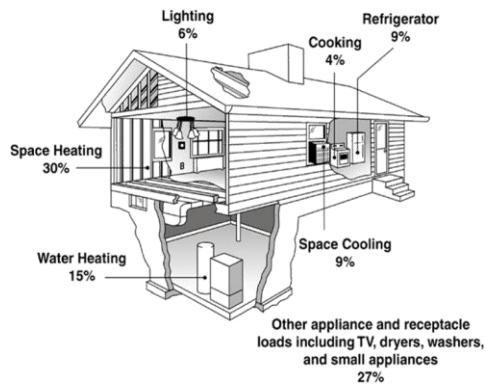
Pier Construction			
4.1301.6a	Subfloor preparation	Sealing between house and crawl space will be completed before insulating	Ensure airtight envelope Prevent leakage
4.1301.6b	Installation	Insulation will be installed in contact with subfloor without gaps, voids, compressions, misalignments, or wind intrusions If kraft-faced batts are used, they will be installed with kraft facing to subfloor Insulation will be installed to prescribed R-value	Insulate to prescribed R-value
4.1301.6c	Secure batts	Batts will be secured with physical fasteners	Ensure insulation remains in contact with subfloor
4.1301.6d	Rigid air barrier	A rigid air barrier will be mechanically fastened to underside of floor assembly Seams and penetrations will be sealed	Protect insulation
4.1301.6e	Occupant education	Documentation of material and R-value will be provided to occupant	Provide occupant with documentation of installation

Basement Walls			
4.1402.2a	R-value	Regional IECC will be followed for required R-values	Improve thermal performance of the basement and living space
4.1402.2b	Air barrier	A continuous air barrier will be installed on the warm side of the insulation	Prevent condensation on the basement wall
4.1402.2c	Vapor permeability	When absorbent insulation materials are installed, assembly will remain vapor permeable to the interior in all climate zones except Zone 7	Provide drying potential to the basement

11000 Baseload and General Heat Waste

Baseload reduction measures are designed to reduce the energy consumed by inefficient or outdated appliances and can make a substantial difference in household utility consumption. General heat waste measures are measures that are assumed to be cost effective or often serve to increase client comfort.

Energy Use in a Typical Low-Income Household



11100 Refrigerator Evaluation

Refrigerators located in weatherized dwellings shall be evaluated for potential replacement based on energy consumption. Refrigerator evaluation criteria shall include the following:

- A) Only one standard, full-size, residential refrigerator or refrigerator and freezer combination (in a two for one trade out) that are actively in use shall be considered for replacement.
- B) The cost-effectiveness of replacing a refrigerator shall be determined by using the annual kW usage of the appliance to calculate the SIR.
- C) For the refrigerator replaced one or more existing refrigeration appliances must be determined to contribute to a combined SIR of 1.0 or greater.
- D) Multiple refrigeration appliances operating in a single dwelling may contribute to a combined SIR of 1.0 or greater; therefore, where present multiple appliances should be evaluated.
- E) Every appliance contributing to a combined SIR of 1.0 or greater resulting in a replacement must be permanently removed from service and appropriately de-manufactured per applicable federal regulations.
- F) Replacement appliances shall comply with applicable federal energy efficiency standards.
- G) Replacement appliances shall not have through-the-door ice or water features. There are **no** exceptions to this policy and waivers shall not be granted.
- H) An effective economic life of 15 years shall be used for evaluation purposes.
- I) A minimum of 10% of all appliances replaced shall be evaluated using the metering method, rather than using a database.
- J) Under no circumstances shall a stand-alone freezer be replaced.
- K) Under no circumstances shall a refrigerator that is nonfunctioning be replaced.
- L) Under no circumstances shall a refrigerator be replaced based solely on age or appearance.
- M) Under no circumstances shall a refrigerator be replaced based solely on an operating malfunction not related to energy consumption.

Refrigerator and Freezer Replacement			
7.8001.1a	Selection	<p>Appliance shall be ENERGY STAR® rated</p> <p>Appliance will fit in the available space without blocking access to light switches, cabinets, etc.</p> <p>Appliance will carry a minimum one-year warranty that will provide a replacement appliance if repeated issues relating to health, safety, or performance occur</p>	<p>Ensure occupant satisfaction with appliance</p>
7.8001.1b	Installation	<p>Appliance will be installed in accordance with manufacturer specifications and local codes</p> <p>Any penetrations to the exterior of the home created by the installation of the appliance will be sealed</p> <p>Energy-related appliance controls will be demonstrated to the occupant</p> <p>Specific information on the proper maintenance of the equipment will be provided to the occupant</p> <p>Warranty information, operation manuals, and installer contact information will be provided to the occupant</p>	<p>Achieve intended appliance function</p> <p>Preserve food at low energy use</p> <p>Educate occupant on how to operate and maintain the appliance</p>
7.8001.1c	Decommissioning	<p>Appliances replaced by new units will be recycled or disposed of in accordance with federal, state, or local regulations</p> <p>Appliances infested with pests will be enclosed before moving</p>	<p>Prevent reuse of inefficient equipment and components</p> <p>Protect the environment</p> <p>Protect worker safety</p>

11110 (2-for-1) Refrigerator Replacement Option

Households where multiple refrigeration appliances consume energy year round may benefit greatly from a reduction in the number of appliances in use. Clients should be encouraged to discontinue use of any appliance that is not in active use or that consumes a large amount of energy.

Where a refrigerator-only evaluation results in an SIR of less than 1.0, the annual kW usage of an additional refrigeration appliance may be considered to achieve a combined SIR of 1.0 or greater qualifying the household for a refrigerator replacement.

Example:

Household (A) actively uses one 18 ft³ refrigerator that is 14 years old. Household (A) also actively uses one stand-alone freezer that is 9 years old. Household (A) additionally has a compact or mini refrigerator in the basement that is rarely used but stays on year round. Under this scenario, the 2-for-1 Replacement Option should be considered for Household (A).

Eligibility for the 2-for-1 Replacement Option would be determined by comparing the cost effectiveness of providing one larger, more efficient refrigerator/freezer combination to replace the existing, inefficient refrigerator/freezer combination and the stand-alone freezer.

Where the combined annual kW usage of the one 18 ft³ refrigerator/freezer combo and the one stand-alone freezer, when compared to the purchase price and annual energy consumption of one new, energy efficient 21 ft³ refrigerator/freezer combination results in an SIR of 1.0 or greater, then the 2-for-1 Replacement Option is appropriate. The inefficient refrigerator/freezer combo and the stand-alone freezer must both be removed and appropriately demanufactured.

Though it may not be considered as part of the 2-for-1 Replacement Option, client education shall additionally be provided encouraging Household (A) to discontinue use of the compact refrigerator located in the basement as a means of further reducing household energy consumption.

11120 Refrigerator Evaluation Methods

Refrigerator evaluation shall occur in two stages:

A) Refrigerators Less Than 10 Years Old:

- a) weatherization personnel shall determine the manufacture date of the appliance (when possible) by checking the service tag generally located inside the unit .
- b) the model number, serial number, manufacture date, and method of determination shall be documented in the job file.
- c) for appliance determined to be less than 10 years, no further action shall be required.

B) Refrigerators 10 Years Old or Older (or where age cannot be determined):

- a) complete steps a) and b) above.

- b) annual kW usage shall be determined by either metering or obtaining estimated annual kW usage from an approved appliance database.
- c) using annual kW usage data, the cost-effectiveness of replacing the appliance shall be determined by calculating the SIR.
- d) refrigerators determined to have an SIR of 1.0 or greater shall be replaced per applicable standards.
- e) the SIR, evidence of calculation method, specification data for replacement appliance, and photographic documentation of the appliance removed shall be maintained in the job file.
- f) refrigerators with an SIR of less than 1.0 shall not be replaced, except where the 2-for-1 Replacement Option is applicable.

11200 Lighting Upgrades

Incandescent bulbs in use one hour or more per day shall be replaced with compact fluorescent lamps (CFLs) or light-emitting diodes (LED). Installed CFLs LEDs shall have a lumen rating equivalent to or higher than the incandescent bulb being replaced to maintain equivalent light output levels wherever possible. Standard CFL's are not made to be placed in ceiling fans or on dimmer switches. If CFLs are placed in ceiling fans, then CFLs rated for ceiling fans shall be installed. If CFLs are placed on dimmer switches, then CFLs rated for dimmer switches shall be installed. LEDs do not have these limitations on placement.

No limit shall be placed on the quantity of CFLs or LEDs installed, so long as usage is evaluated on a case-by-case basis and replacement is supported by the one-hour-or-more daily usage criteria or by a documented SIR of 1.0 or greater. Failing to install CFLs or LEDs in locations used at least one hour per day shall not be allowed.

Client education shall be provided explaining the differences between CFLs and incandescent bulbs, including proper disposal methods, and shall be repeated as needed during the installation process.

Lighting Upgrade			
7.8003.1b	Selection	<p>All bulbs, fixtures, and controls will be appropriate for the intended application (e.g., enclosed, orientation, dimmable, potential for breakage, indoor, and outdoor)</p> <p>All bulbs, fixtures, and controls will be selected to provide the brightness and light quality required in that application (e.g., task lighting, trip-and-fall hazards, nightlights)</p> <p>Selected equipment should have the highest level of efficiency within a technology [e.g., compact fluorescent lamp (CFL), LED]</p> <p>All bulbs, fixtures, and controls will be ENERGY STAR® rated where applicable</p> <p>When possible, bulbs, fixtures, and controls will be selected that will facilitate the use of future lighting technologies (e.g., LEDs)</p> <p>When incandescent bulbs cannot be replaced or when occupant chooses not to replace, a dimmer will be selected</p> <p>Power quality will be evaluated before new lighting is selected</p> <p>Light/lamp wattage should not exceed rated wattage of fixture</p> <p>Bulb replacements will be chosen based on expected durability, light quality, and lifetime energy use of the bulb</p> <p>Controls to turn off lights when not needed (e.g., no one in room) will be provided</p> <p>All bulbs, fixtures, and controls will be UL-approved and installed in accordance with local code(s) and NFPA 70 National Electric Code</p> <p>Fluorescent light ballasts containing polychlorinated biphenyls (PCBs) will be replaced in accordance with the EPA's Healthy Indoor Environment Protocols for Home Energy Upgrades</p>	<p>Provide improved lighting quality at lower energy use</p> <p>Select equipment that will not be an unnecessary barrier to future technologies</p> <p>Avoid inferior products and unsatisfied occupants</p>

11300 Water Heat Loss Measures

Water heaters and associated hot and cold water pipes shall be insulated to reduce conductive heat loss in all dwellings weatherized. Wrapping the cold water pipes is required because hot water from the tank is pulled up into the cold water pipes due to thermosiphon action. The first 6 ft. of the hot and cold water line leading into and out of the unit shall also be insulated.

Water heaters shall be insulated to an insulation value of R-5 or greater using mineral fiber insulation with an attached protective backing installed facing outward and zip ties to mechanically fasten the insulation. Foil bubble reflective insulation is **not** permitted. Exceptions to water heater insulation standards shall include:

- A) Cabinet style water heaters and units labeled with instructions indicating “Do Not Wrap”
- B) Water heaters located within 3 ft. of any type of furnace or stove, regardless of fuel source.

Pressure relief valves shall be present on all units and associated valve piping shall terminate not more than 6 in. above the floor or, depending on local code specifications, terminate outside the perimeter of the dwelling.

In localities where outdoor termination is required, valve piping shall have an air gap located in the same room as the water heater, prior to the discharge entering into piping terminating outdoors. Exceptions to the installation of pressure relief piping to the outdoors standards shall include:

- A) Cabinet style water heaters
- B) Water heater located in underpinned/dugout/excavated basement
- C) Water heater located in the center of a dwelling on the first floor of slab on grade
- D) Water heater located in standalone structure.

Client education shall be provided explaining potential energy savings related to reducing the temperature and quantity of household hot water usage.

Wherever possible, weatherization service providers shall obtain verbal client authorization to adjust water heater thermostat settings to a temperature of 110°- 120°F. Where the client chooses to decline the measure, written documentation shall be maintained in the job file.

A) Electric Water Heater Insulation

The following standards shall apply to electric water heater insulation measures:

- a) insulation shall be applied to the top and sides of the water heater.
- b) overlapped ends of the protective backing material shall be sealed and banded in order to provide an adequate seal.
- c) the pressure relief valve and piping shall not be covered.
- d) thermostat controls shall be clearly marked and panels shall be insulated but readily accessible.

B) Fuel-Fired Water Heater Insulation

The following standards shall apply to natural gas and liquid propane water heater insulation measures:

- a) insulation shall be applied to only the sides of the water heater.
- b) overlapped ends of the protective backing shall be sealed and banded in order to provide an adequate seal.
- c) a clearance of not less than 3 in. shall be maintained between insulation and the base of the appliance.
- d) a clearance of not less than 3 in. shall be maintained between pipe insulation and the draft hood.
- e) insulation shall not cover the pilot light, cut-off valve, the access panel to the thermostat or heating elements, operating instructions, the pressure relief valve or piping, the drain, any electrical service wiring, or the high-limit switch.

Maintenance			
7.8103.1a	Health and safety	<p>Combustion safety testing will be performed in accordance with the Health and Safety Chapter of the Standard Work Specifications for Single Family Housing or other equivalent practice</p> <p>Electrical components will be verified to comply with NEC (e.g., no electrical box connector, no disconnect, improperly sized breaker and wire)</p>	Identify potential health and safety issues
7.8103.1b	Visual inspection	<p>Inspection will be conducted to show compliance with the 2012 IRC, including but not limited to:</p> <ul style="list-style-type: none"> • Water or fuel leaks • Damaged wiring • Venting issues with draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence) • Corrosion (e.g., rust, mineral deposits) • General condition of components 	Determine needed repairs or maintenance
7.8103.1c	Thermal efficiency	<p>Water heater storage tanks shall have a minimum R-value of R-5</p> <p>Added insulation will not obstruct the unit's draft diverter, pressure relief valve, thermostats, hi-limit switch, plumbing pipes or elements, and thermostat access plates</p> <p>The first 6' of inlet and outlet piping will be insulated in accordance with 2012 IRC N1103.4.2 or local requirements, whichever is greater</p>	<p>Reduce standby losses from near tank piping and storage tank</p> <p>Ensure insulation does not make contact with flue gas venting</p>
7.8103.1e	Temperature and pressure relief valve	<p>Correct temperature and pressure relief valve will be installed in compliance with P2803 of the 2012 IRC and according to manufacturer specifications</p> <p>Temperature and pressure relief valve discharge tube will be installed in accordance with P2803.6.1 of the 2012 IRC</p>	Discharge excessive energy (pressure or temperature) from storage tank to safe location
7.8103.1f	Maintenance records	<p>Occupants will be advised to keep records of all maintenance done to their system</p> <p>Copies of or access to installation and operation manuals will be provided</p>	Provide a history of system installation and maintenance to improve chance of successful future maintenance or repair
7.8103.1g	Occupant safety	<p>Carbon monoxide (CO) alarms will be installed in each dwelling in accordance with ASHRAE 62.2 and authority having local jurisdiction</p> <p>Occupant will be provided information regarding the health effects and risk of high CO concentrations as well as a list of monitors that can provide more detail regarding CO levels</p>	<p>Ensure occupant life safety</p> <p>Inform occupant regarding possible CO hazards</p>
7.8103.1h	Occupant education	<p>Completed work will be reviewed</p> <p>Occupants will be educated on the safe and efficient operation and maintenance of the system, including:</p> <ul style="list-style-type: none"> • Adjustment of water temperature and target temperature in accordance with local code • Periodic drain and flush • Periodic inspection, maintenance, or replacement of anode rod 	Ensure occupant is informed of the safe, efficient operation and maintenance of the system

11310 Water Flow Reduction Measures

Allowable water flow reduction measures in weatherized dwellings shall include installation of low flow showerheads and faucet aerators. Flow reducers shall be composed of durable materials and shall be as similar in design and finish to the associated fixture as possible.

Water flow reducers that are installed shall be rated to provide a maximum flow rate of:

- A) Shower heads - equal to or less than 2.0 gallons per minute (gpm)
- B) Faucets aerators - equal to or less than 1.5 gpm.

Where the condition of the plumbing is such that damage could result from this installation, this optional measure shall be attempted only by a licensed plumber.

Shower Head and Faucet Aerator			
7.8101.1a	Work assessment	Installer pre-work assessment will be conducted to determine if plumbing needs correction before installing high-efficiency shower head or faucet	Verify scope of work
7.8101.1b	Selection	<p>The rated flow of new shower heads will be 2.0gallons per minute (GPM) or less</p> <p>If multiple heads are provided, the total flow rate will not exceed 2.5 GPM</p> <p>Aerator flow rate will be 1.5 GPM or less</p> <p>Features will be selected that meet any special needs of the occupant (e.g., shut off, swivel, handheld showers)</p>	<p>Reduce water and energy consumption</p> <p>Ensure occupant satisfaction</p>
7.8101.1c	Installation	<p>Equipment will be installed in accordance with manufacturer specifications and meet all applicable building codes</p> <p>Water quality will be evaluated for debris that may clog the equipment</p> <p>Once installed, high-efficiency shower heads or faucet aerators will be tested to determine if equipment is tightened adequately to prevent leakage at the point of connection</p> <p>If needed, shower diverter will be repaired or replaced</p> <p>Any penetrations to the exterior of the home created by the installation of the equipment will be sealed</p> <p>Any damage done to the house during installation will be repaired</p> <p>Specific information about proper maintenance of the equipment will be provided to the occupant</p> <p>Warranty information, operation manuals, and installer contact information will be provided to the occupant</p> <p>Water flow that satisfies the occupant will be provided by all shower heads and faucet aerators</p> <p>Occupant's acceptance of the shower head and/or aerator will be documented</p>	<p>Reduce water and energy consumption</p> <p>Ensure occupant satisfaction with water flow</p> <p>Eliminate water leakage</p> <p>Prevent water damage</p>
7.8101.1d	Decommissioning	Replaced shower heads and faucet aerators will be recycled or disposed of properly	Prevent the reuse of inefficient equipment and components

11400 Weather stripping and Door Sweep Installation

These low-cost items target client comfort and shall only be allowed after all other cost-effective energy efficiency measures are complete.

Where weather stripping or door sweeps are installed, only durable materials shall be used. Universal weather stripping kits constructed of vinyl, silicone, or wrapped foam with metal or wood flanges shall be allowed. Self-adhesive or open cell foam weather stripping shall be allowed where use of a more durable product is not feasible for a particular application, but under no circumstances shall it be installed on doors.

12000 Incidental Repairs

Incidental repairs are those repairs necessary for the effective performance or preservation of weatherization materials. Such repairs include, but are not limited to, framing or repairing windows and doors which could not otherwise be caulked or weather-stripped, and providing protective materials, such as paint, used to seal materials installed under WAP. Except where explicitly cited, dwellings that require incidental repairs must have a site-specific computerized audit to ensure that the package of measures do not reduce the overall SIR to less than 1.0. Incidental repairs must be included in the SIR calculation. If the projected incidental repairs drop the total SIR below 1.0 and there is no other non-federal funds to leverage, the dwelling must be deferred or the measure and incidental repair removed. If the measure and incidental repair is removed, it must be determined if weatherization services can still be rendered. The following repairs must be cost-justified through a properly executed computerized audit:

- A) Replacing deteriorated window or doors (for non-cost justified reasons)
- B) Repairing minor roof leaks
- C) Minor floor reinforcement
- D) Minor ceiling reinforcement
- E) Backing for wall insulation for an exterior closet (not knee walls)

Window or door replacement work that cannot be cost-justified through WA, shall be defined as an "incidental repair" as per DOE regulation CFR 440.3. The replacement work shall be considered only as a last resort, where the existing window or door is weathered or damaged beyond repair, or poses a hazard to building durability. Incidental repair window or door replacement measures shall be allowable only where expenses associated with the replacements can be supported (or cost-justified) based upon maintaining a cumulative SIR attributable to the entire proposed scope of work for the project of 1.0 or greater.

Manufactured Home Section

This section provides guidance and requirements pertaining to manufactured homes. For any processes, procedures or requirements not specifically mentioned in this section, the processes, procedures, and requirements referred to in the current Installation Standards shall also apply to manufactured homes.

Standard Work Specification Manufactured Crosswalk

SWS Section	Installation Standards Section	SWS Section	Installation Standards Section
2.0201.2	27100	4.1003.10	30123
2.0602.2	30100	4.1003.11	30123
3.1001.4	29000	4.1003.8	30120
3.1101.1-3	29000	4.1003.9	30121
3.1201.5	32000	4.1008.6	30123
3.1202.3	32000	4.1104.1	30320
3.1203.3	32000	4.1302.1	30230
3.1301.1	30230	4.1303.1	30220
3.1301.2	29000	4.1303.2	30220
3.1302.1	29000	5.3001.3	28210
3.1602.8	28100	5.3003.12	27410
3.1602.9	28220	5.3202.1	30130
3.1701.1	29000	6.6204.1	25130

22000 Workflow Documentation

22100 Weatherization Assistant Energy Audit Software

The Mobile Home Energy Audit (MHEA) portion of the Weatherization Assistant (WA) shall be used for manufactured dwellings. Measures requiring the use of the WA software shall include, but not be limited to:

- A) Incidental repairs lacking a direct relationship to priority list measures
- B) Replacing windows or doors
- C) HVAC sizing for system installations required to establish adequate primary heat sources.*

Dwellings in which no air sealing is needed and in which adequate insulation in the roof cavity, sidewalls, and belly is already present shall require a WA audit in order to ensure that the entire job will still be cost-effective.

The WA software tools may additionally be used to cost-justify refrigerator replacements and to assess the cost-effectiveness of certain health and safety measures, where applicable, to support the leveraging and efficient management of program resources.

One or more weatherization personnel members employed by each weatherization service provider shall possess a thorough working knowledge of the WA software packages.

*MHEA software cannot be used in the sizing of a cooling load for a manufactured home. A Manual J or comparable load calculation software shall be used for this function.

22200 State Historic Preservation Office Authorization

Manufactured homes are exempt from SHPO requirements. Even in a historic district, they are considered noncontributing structures.

23000 Priority List of Measures

Measures shall be completed on manufactured homes in the order prioritized below. If a specific measure is skipped without proper documentation or justification, any measures lower on the priority list that are performed may result in disallowed cost.

23100 Priority List of Measures for Mobile Homes

1. Energy Related Health and Safety

(Chapters 5000, 6500, 7000, 25000)

2. Duct Sealing

(Chapter 25000 – Duct Sealing and Insulating)

3. Air Sealing

(Chapters 9000 & 29000 – Air Sealing)

4. Lighting

(Chapter 11000 – Baseload Reduction and General Heat Waste)

5. Side Wall Insulation

(Chapter 29000 – Insulation)

6. Refrigerator Replacement

(Chapters 11000 & 31000 – Baseload Reduction and General Heat Waste)

7. Roof Insulation

(Chapter 30000 – Insulation)

8. Floor Insulation

(Chapter 30000 – Insulation)

9. Glass Storm Windows

(Chapter 29000 – Air Sealing)

25000 Health and Safety Provisions

25110 Vapor Barriers

Vapor barriers in manufactured home applications shall only be required in manufactured homes with permanent foundations. Vapor barriers installed under manufactured homes with a permanent foundation shall follow all requirements of their application in single family dwellings.

Vapor barriers are allowable under manufactured homes with and without perimeter skirting, but shall not be required. Vapor barriers in manufactured home applications shall not be sealed to perimeter skirting. It is recommended that extra landscaping pins be used to secure the perimeter of the vapor barrier when it is installed for manufactured homes without permanent foundations.

25120 Moisture Diversion

Installation of gutters in the form of J-channel shall be allowed if existing J-channel is damaged in the process of insulating the manufactured home roof cavity. Minor leaks in the J-channel and between the J-channel and the manufactured home shall be sealed with butyl putty tape.

25130 Ventilation

At least one full bathroom in every manufactured home shall be equipped with a timer-equipped local exhaust ventilation fan with a noise rating equal to or less than 3 sones and an installed airflow rate of not less than 50 CFM. To increase the probability of uniform compliance with this standard, devices installed in bathrooms shall have a rated airflow specified by the device manufacturer of not less than 70 CFM.

Exhaust fans that exist at the time of the energy assessment shall be tested (commissioned) by the auditor. If deficiencies are noted, those deficiencies shall be corrected, to the extent practicable, during weatherization.

Commissioning existing exhaust fans			
6.6204.1a	Systems check	Visual inspection will be performed and documented for: <ul style="list-style-type: none">• Electrical connections• Name plate (rated sone and flow)• Damper operation (internal and external)• Motor cleanliness Ducts: <ul style="list-style-type: none">• Connections (proper materials, sealed and connected)• Insulation• Support• Sizing• Termination	Evaluate systems
6.6204.1b	Verify flow rate	Calibrated device will be used to test for flow measurement	Ensure proper flow
6.6204.1c	Work order	Work order will be developed as necessary in accordance with systems check and flow rate	Correct deficiencies Ensure proper operation
6.6204.1d	Total ventilation airflow	Total exhaust and/or supply system ventilation airflow will be measured	Ensure airflow is as designed

Decommissioning Existing Exhaust or Supply Ventilation Systems			
6.6206.1a	Power supply	Power supply will be disconnected and properly terminated in visible junction box	Safe removal of equipment Ensure worker safety
6.6206.1b	Removal	Fan components will be removed and disposed of lawfully Duct work will be removed if necessary OR Fan housing will be left in place, ducts will be removed, and leakage points will be air sealed Hole will be sealed and insulated to preserve the thermal and pressure boundary	Remove fan Preserve aesthetics, and thermal and pressure boundary
6.6206.1c	Repair	Fan opening will be sealed and insulated If necessary, the void from the duct work removal will be insulated Fan termination will be sealed	Maximize energy efficiency Preserve the thermal and pressure boundary
6.6206.1d	Combustion Appliance Zone (CAZ) testing	Combustion safety test will be performed where combustion appliances are utilized	Identify possible conditions that can cause unsafe equipment operating conditions

25140 Lead-Safe/Renovate Right

Lead paint was not used in the building of manufactured homes, but may be found in varnishes and stains in mobile homes remodeled before 1978.

26000 Diagnostic Testing

26100 Zonal Pressure Diagnostics

Due to differences in construction techniques, zonal pressures of less than 45 Pascals shall be acceptable. ZPDs shall be performed in belly of a manufactured home, but are not required in the roof cavity.

In doublewide manufactured homes, ZPDs WRT the conditioned space shall be taken in the marriage wall of the manufactured home. The marriage wall shall be as close to 0 WRT the conditioned space as possible. ZPDs WRT the conditioned space shall also be taken on both sides of the belly in a doublewide manufactured home.

27000 Heating, Cooling, and Ventilating Systems

27100 Fuel-Fired Heat Source Requirements

Manufactured homes shall adhere to the requirements listed in the HUD Mobile Home and Safety Standards (3280.709, G), including, but not limited to:

- A) All fuel-fired appliances, excepting ranges, clothes dryers, and solid-fuel burning fireplace stoves, shall be installed to provide for the complete separation of the combustion system from the interior atmosphere of the manufactured home. This shall be accomplished by installing a sealed combustion direct-vent system.

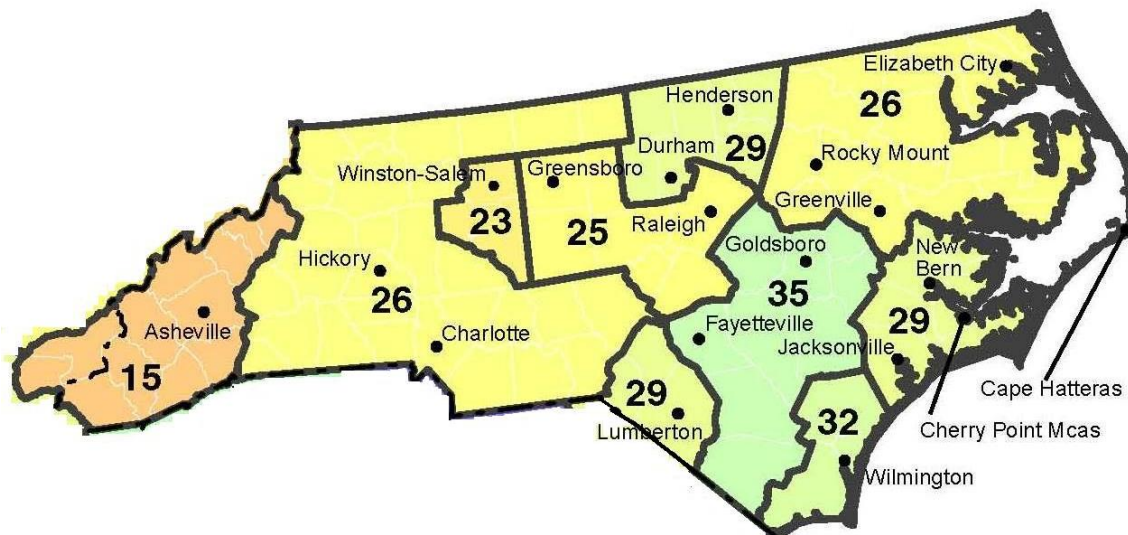
Combustion Safety			
2.0201.2a	Outside combustion makeup air	Combustion air will be provided from the outside and, where applicable, in accordance with the 2012 IRC for the type of appliance installed	Prevent combustion byproducts from entering the house
2.0201.2b	New appliances	New appliance will be installed in accordance with manufacturer specifications, 2012 IRC G2427.8, and additional applicable codes Replacement equipment venting will be assessed to ensure other existing equipment is not adversely affected	Prevent combustion byproducts from entering the house

- B) All fuel-fired appliances, excepting ranges and clothes dryers, shall be equipped with code compliant venting systems capable of close clearances with combustibile materials.
- C) Solid-fuel burning fireplaces or fireplace stoves shall be equipped with integral door(s) or shutter(s) designed to close the fire chamber opening, and shall include complete means for venting through the roof, combustion air inlet, hearth extension, a spark arrestor installed on the chimney cap, and means to securely attach the fireplace or fireplace stove to the manufactured home structure.

27220 Replacement System Sizing

All installed systems shall be specifically designed for manufactured homes. At the time of this publication, MHEA is not designed to calculate the sizing of a cooling load for a manufactured home. The chart and diagram below can be used to compare a third-party Manual J or comparable equipment-sizing software results.

Sizing Chart for Cooling Area for Manufactured Homes										
Zone	Floor Area (square feet)									
	1 - 840	841 - 1,120	1,121 - 1,280	1,281 - 1,440	1,441 - 1,680	1,681 - 1,960	1,961 - 2,240	2,241 - 2,520	2,521 - 2,760	2,761 - 3,000
15	1.5	1.5	2	2	2.5	2.5	3	3	3.5	3.5
23	1.5	2	2	2.5	3	3	3.5	4	4	4.5
25	1.5	2	2.5	2.5	2.5	3	3.5	4	4	4.5
26	1.5	2	2.5	2.5	3	3	3.5	4	4.5	4.5
29	2	2	2.5	2.5	3	3.5	4	4	4.5	5
32	2	2.5	2.5	2.5	3	3.5	4	4.5	4.5	5
35	2	2.5	2.5	3	3	3.5	4	4.5	5	5
Adapted chart from the Manufactured Housing Research Alliance										



27410 System Maintenance

Package Unit			
5.3003.12a	Work assessment	<p>Assessment will be performed to identify problems with air, refrigerant, electrical, load, safety, indoor environmental quality (IEQ), and/or other needed repairs</p> <p>If new installation or replacement is necessary, ACCA Manual J, Manual S, and/or Manual D will be referenced to determine if the existing duct system is adequate for the sizing of the furnace, and the procedures outlined in ANSI/ACCA 5 QI-2010 HVAC Quality Installation Specification will be followed</p>	Determine the scope of repair, service, and level of expertise required to perform the work

5.3003.12b	Remove existing system components	<p>Non-salvageable components and waste will be removed and disposed of properly</p> <p>Refrigerant will be removed in accordance with EPA requirements</p>	<p>Prepare for installation of new equipment or components</p> <p>Ensure environmental and legal compliance</p>
5.3003.12c	Repairs	<p>Repairs will be performed by qualified specialist as identified in the assessment</p> <p>Maintenance will be done in accordance with ANSI/ACCA 4 Maintenance of Residential HVAC Systems-2007 and ANSI/ACCA 6 HVAC System Cleanliness-2007</p>	Optimize performance of the system
5.3003.12d	Service existing components	<p>Service will be performed by qualified personnel as identified in the assessment</p> <p>Maintenance will be done in accordance with ANSI/ACCA 4 Maintenance of Residential HVAC Systems-2007 and ANSI/ACCA 6 HVAC System Cleanliness-2007</p>	Optimize performance of the system
5.3003.12e	Commissioning	<p>Equipment will be fully tested for proper operation following procedures outlined in ANSI/ACCA 5 QI-2010</p> <p>Property manager/occupant will be educated on how to operate and maintain system, including thermostat operation and system changes</p>	<p>Ensure proper system operation</p> <p>Ensure property manager/occupant is educated</p>

28000 Duct Sealing and Insulation

28100 Duct Sealing

The end of the duct plenums shall be sealed with rigid board insulation, an insulation-filled plastic bag, or a mastic-coated hog hair filter and placed at least 12 in. beyond the last register opening in order to retain balanced airflow. Gaps between the walls of the plenum must be sealed with mastic. When using rigid board insulation, mesh tape shall be used to seal gaps exceeding ¼ in.

The connection between the plenum and the furnace shall be sealed. This connection is typically located underneath the furnace. This connection can sometimes be accessed from interior space; if not it will be necessary to cut open the belly liner and access it from beneath the manufactured home. Photographic documentation is required if this measure cannot be performed.

Duct systems in manufactured homes do not require insulation that is separate from that of the belly insulation.

Supply Plenum (Furnace to Trunk Duct Connection)			
3.1602.8a	Work assessment	Installer prework assessment will be conducted to determine: <ul style="list-style-type: none">• Size of plenum• Alignment• Connection method• Existing sealing	Ensure an efficient and effective way to accomplish work Verify scope of work
3.1602.8b	Preparation	Debris will be removed Surface will be prepared for work (e.g., remove tape, oil) Floor will be prepared to receive the appropriately sized plenum	Provide unobstructed path for work access and air flow Ensure adhesion of materials to be installed Provide a properly sized plenum to maximize distribution of air flow (equal to the furnace discharge)
3.1602.8c	Plenum rebuild or repair	Plenum will be rebuilt or repaired using compatible materials and will be: <ul style="list-style-type: none">• Mechanically fastened• Sealed• Durable• Structurally sound• Insulated• Equipped with a vapor retarder where climate appropriate If possible, flow diverter or turning vanes will be installed for air flow and/or balancing (e.g., bullhead Ts, offset air handler)	Minimize restrictions Maximize air flow and air distribution Minimize moisture issues Prevent condensation on plenum

3.1602.8d	Repair work access	Point of access options include: Option 1: Through the trunk duct <ul style="list-style-type: none"> • Repair and seal access hole in the trunk duct • Install insulation • Repair belly/bottom liner Option 2: Remove crossover duct <ul style="list-style-type: none"> • Reattach crossover duct • Seal and insulate crossover duct • Repair belly/bottom liner Option 3: Remove air handler <ul style="list-style-type: none"> • Install new gasket, if necessary • Mechanically attach furnace to the structure • Reconnect utilities • Replace and seal panels Option 4: Through the furnace panel <ul style="list-style-type: none"> • Replace and seal panels 	Repair work access Prevent condensation Minimize heat loss and heat gain from plenum
3.1602.8e	Safety testing	Equipment will be cycled Combustion Appliance Zone (CAZ) test will be performed where combustion appliances are utilized	Verify operation Identify unsafe equipment operating conditions
3.1602.8f	Performance testing	Pre- and post-retrofit duct leakage will be performance tested using a duct blaster or pressure pan, and results will be documented and reported to the homeowner and/or program	Document post-retrofit duct leakage test has been performed

28200 Distribution System Repair and Replacement

Every effort shall be made to repair the existing distribution system components before replacement is considered. If register boots are damaged to the point where adequate air sealing is neither possible nor cost-effective, new boots may be constructed using aluminum coil stock or a comparable material. Prefabricated register boots may be purchased and installed if available.

The plenum may be repaired and/or patched for the purposes of air sealing ducts by using aluminum or steel sheets that are not less than 30 GA in thickness. The patch must be attached to the trunk line using stainless or galvanized screws 1 in. or less in length and sealed with duct mastic. All duct sealing and repairs done from beneath the manufactured home must be completed prior to insulating the manufactured home belly.

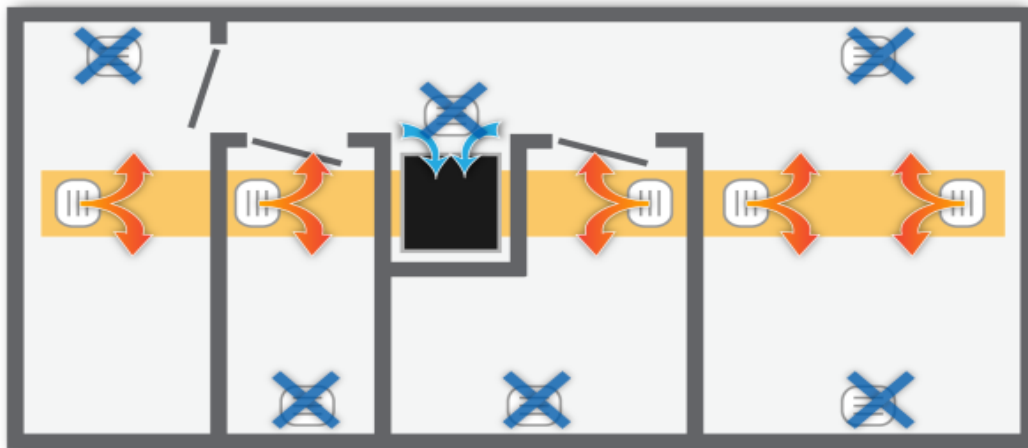
Support for Horizontal, Suspended Ducts			
3.1601.4a	Support (applies to all duct types)	Flexible and duct board ducts and plenums will be supported where feasible in accordance with flex duct manufacturer specifications and local codes Support materials will be applied in a way that does not crimp ductwork or cause the interior dimensions of the ductwork to be less than specified (e.g., ceiling, framing, strapping) Metal ducts will be supported by metal strapping, rods, or other materials, where feasible	Eliminate falling and sagging

28210 Belly Return Conversions

Under no circumstances shall the belly of a manufactured home be used as a return plenum. If such a circumstance is discovered, a central return must be created by:

- A) Replacing the solid furnace door with a louvered door or retrofitting the existing door with an appropriately sized return grill. In either case, an appropriately sized filter grill must be supplied.

- B) Air sealing the belly return grilles in the floors of bedrooms, bathrooms, kitchen, living area, etc. and in the floor of the furnace closet, if one exists. Air sealed return grills must be tested and readings must be 0.5 Pa or less.



In manufactured homes with belly returns, room pressures may increase significantly once the system has been converted to a central hallway return system. Retest the room pressures after the belly return conversion and take the appropriate measures if the room pressures are greater than +/- 3 Pa WRT the outdoors.

Replace Return Air Systems that Incorporate Floor Cavity			
5.3001.3a	Close return air openings	Existing return air openings will be closed off and sealed with a durable material equivalent in strength to the surrounding material Disturbed materials suspected to contain asbestos or lead content will be assessed and removed in accordance with EPA regulations	Minimize air leakage Improve indoor environmental quality Ensure safe and legal renovation
5.3001.3b	Alternate return air system	Alternate return air opening will be provided to the furnace closet (e.g., replace louvered door or install grilles); whenever possible, follow manufacturer specifications for amount needed Return duct design will be in accordance with ANSI/ACCA 1 Manual D Residential Duct Systems A continuous and adequate return air pathway to the air handler will be installed	Ensure sufficient return air is provided to the system
5.3001.3c	Zone pressure test	Pressures will be measured with the furnace fan operating across interior doors that can be closed and have a supply and/or return behind them Rooms should not exceed 3 pascals of pressure Pressure testing will be performed with all interior doors closed and the air handler running	Ensure sufficient return air is provided to the system Minimize moisture intrusion from negative pressures Improve indoor air quality
5.3001.3d	Combustion Appliance Zone (CAZ) testing	CAZ testing will be performed where combustion appliances are utilized	Identify unsafe equipment operating conditions
5.3001.3e	Occupant education	Occupant will be educated on changes, how to operate and maintain the system, and any potential health concerns (e.g., lead, asbestos)	Ensure occupant is educated

28220 Crossover Ducts

Crossover ducts shall be inspected for integrity and repaired or replaced if any part of the insulation or inner liner is brittle or damaged. The duct must be replaced if the inner liner is composed of a mesh material. If replacement is required, either rigid metal ductwork or foil-wrapped flex duct with a minimum insulation R-value of R-8 shall be installed. Crossover duct runs, whether rigid or flexible, shall be as straight and short as possible and suspended off the ground.

Crossover Ducts			
3.1602.9a	Work assessment	Installer prework assessment will be conducted to determine: <ul style="list-style-type: none"> • Location • Types • Leakage points 	Verify scope of work
3.1602.9b	Flexible crossover duct connections	Flexible crossover duct connections will be added, rebuilt, or repaired using compatible materials and will be: <ul style="list-style-type: none"> • Mechanically fastened at both inner and outer liner • Sealed using UL-listed sealant that is durable, structurally sound, insulated • Equipped with a vapor retarder Whenever possible, rigid elbow or equivalent will be installed in crawl space crossover ducts Floor insulation will be in contact with the outer liner of the crossover duct Crossover duct vapor retarder will be sealed to the bottom liner (e.g., belly fabric) New flex duct installation will be insulated to a minimum of R-8 When feasible, 26-gauge hard duct should be installed If a new crossover is required, it must be insulated to at least R-8 and be air sealed	Ensure lasting durable connections Minimize air leakage and heat transfer Maintain duct diameter around the turns Maximize air flow and distribution
3.1602.9c	Support	Crossover ducts will be installed so they are not in contact with the ground Crossover ducts will be supported in accordance with flex duct manufacturer specifications, local codes Support materials will be applied in accordance with manufacturer specifications for interior dimensions and will not crimp ductwork, dip, or sag	Maximize air flow and distribution Minimize condensation Minimize air leakage and heat transfer
3.1602.9d	Through-the-rim crossover duct	Through-the-rim crossover ducts will be located and accessed through the bottom liner and branch duct; all branch crossover duct connections and end caps will be located and accessed Hole size (air pathway) will be maximized between branch crossover and trunk All connections will be mechanically fastened and sealed inside duct End caps will be sealed	Ensure all connections are identified Maximize air flow and distribution Ensure lasting durable connections Minimize air leakage
3.1602.9e	Repair work access for through-the-rim crossover	Access hole in the trunk duct will be repaired and sealed Insulation will be reinstalled Bottom liner/belly will be repaired	Repair work access Minimize heat transfer
3.1602.9f	Attic crossover	Access to the attic will be created for all attic areas that contain crossover ducts, where feasible Plenum boxes and crossover duct connections will be rebuilt, mechanically fastened, and sealed Access holes will be repaired	Ensure lasting durable connections Minimize air leakage Maximize air flow and distribution Repair work access
3.1602.9g	Combustion Appliance Zone (CAZ) testing	CAZ testing will be performed where combustion appliances are utilized	Identify unsafe equipment operating conditions

3.1602.9h	Performance testing	Pre- and post-retrofit duct leakage will be performance tested using a duct blaster or pressure pan, and results will be documented and reported to the homeowner and/or program	Document post-retrofit duct leakage test has been performed
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29000 Air Sealing Measures

General Penetrations (Electrical, HVAC, Plumbing, Vent Termination, Recessed Lighting)			
3.1001.4a	Work assessment	Installer pre-work assessment will be conducted to determine: <ul style="list-style-type: none"> • Structural integrity • Roof leaks • Insect infestation • Accessibility • Number, type, size, and location of penetrations 	Ensure work space is safe and ready for air sealing Verify scope of work
3.1001.4b	Air sealing penetrations	Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the penetration or hole The infill or backing will not bend, sag, or move once installed All accessible damaged vapor barrier will be repaired Penetration through the air barrier will be repaired	Ensure closure is permanent and supports any load (e.g., wind, insulation, mechanical pressures) Ensure sealant is effective and durable
3.1001.4c	Sealant selection	Sealants will be used to fill holes no larger than recommended by manufacturer specifications Sealants will be compatible with all adjoining surfaces Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction	Create a permanent seal Ensure sealant meets or exceeds the performance characteristics of the surrounding materials Create a continuous seal
3.1001.4d	Ceiling hole repair	Ceiling repair material must meet or exceed strength of existing ceiling material Ceiling repair must span from truss to truss or add blocking as needed for support The backing or infill will not bend, sag, or move once installed All accessible damaged vapor barriers will be repaired Penetrations through the air barrier must be repaired	Ensure ceiling is structurally sound Minimize air leakage Ensure closure is permanent and supports expected wind and mechanical pressure loads Ensure sealant does not fall out
3.1001.4e	Materials	Materials will be used or installed in accordance with product manufacturer specifications	Select materials to ensure durable and permanent repair
3.1001.4f	High temperature application	Only noncombustible materials will be used in contact with chimneys, vents, and flues Local codes will be referenced	Prevent a fire hazard

Exterior Holed and Penetrations			
3.1101.1a	Work assessment	Installer prework assessment will be conducted to determine: <ul style="list-style-type: none"> • Structural integrity • Size of wall stud • Insect infestation • Accessibility • Number, type, size, and location of penetrations 	Ensure work space is safe and ready for air sealing Verify scope of work
3.1101.1b	Materials	Like material and/or compatible materials will be used for repairs Materials will be selected to comply with manufactured housing rules and regulations (e.g., Manufactured Housing Institute)	Select materials to ensure durable and permanent repair
3.1101.1c	Exterior wall air sealing	All holes and penetrations on exterior surface of exterior walls will be sealed to ensure resistance to outdoor elements Intentionally ventilated walls will not be sealed at vent locations (e.g., weep holes) All holes and penetrations on the interior surface of exterior walls will be repaired Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration	Minimize air leakage Maintain durability Ensure resulting closure is permanent and supports expected load Ensure sealant is effective and durable

Walls Interior			
3.1101.2a	Work assessment	Installer prework assessment will be conducted to determine: <ul style="list-style-type: none"> • Structural integrity • Size of wall stud • Insect infestation • Accessibility • Number, type, size, and location of penetrations 	Ensure work space is safe and ready for air sealing Verify scope of work
3.1101.2b	Interior wall air sealing	All accessible holes and penetrations in top and bottom plates will be sealed Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration	Minimize air leakage Maintain durability Ensure resulting closure is permanent and supports expected wind and mechanical pressure loads Ensure sealant is effective and durable
3.1101.2c	Materials	Like material and/or compatible materials will be used for repairs Materials will be selected to comply with manufactured housing rules and regulations (e.g., Manufactured Housing Institute)	Select materials to ensure durable and permanent repair

Marriage Walls			
3.1101.3a	Work assessment	Installer prework assessment will be conducted to determine: <ul style="list-style-type: none"> • Structural integrity • Insect infestation • Accessibility • Number, type, size, and location of penetrations • Identify marriage walls and lines 	Ensure work space is safe and ready for air sealing Verify scope of work
3.1101.3b	Marriage wall air sealing of holes and penetrations	All accessible holes and penetrations in top and bottom plates will be sealed Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration	Minimize air leakage Maintain durability Ensure resulting closure is permanent and supports expected wind and mechanical pressure loads Ensure sealant is effective and durable
3.1101.3c	Marriage line air sealing	All accessible holes and penetrations at marriage lines will be sealed continuously at end walls, floors, and ceiling Backing or infill will be provided at the marriage line as needed All remaining gaps will be sealed with an approved material	Minimize air leakage Maintain durability Ensure sealant is effective and durable
3.1101.3d	Materials	Materials will be used or installed in accordance with product manufacturer specifications	Select materials to ensure durable and permanent repair

Through Flooring			
3.1301.2a	Work assessment	Installer prework assessment will be conducted to determine: <ul style="list-style-type: none"> • Structural integrity • Standing water • Raw sewage • Insect infestation • Pests • Accessibility • Number, type, size, and location of penetrations 	Ensure work space is safe and ready for air sealing Verify scope of work
3.1301.2b	Floor air sealing (decking, subfloor, floor decking)	Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration The backing or infill will not bend, sag, or move once installed	Ensure resulting closure is permanent and supports expected load Ensure sealant is effective and durable
3.1301.2c	Sealant selection	Sealants will be used to fill holes no larger than recommended by manufacturer specifications Sealants will be compatible with all adjoining surfaces Sealants will be continuous and meet fire barrier specifications, if required	Ensure sealant meets or exceeds the performance characteristics of the surrounding materials

3.1301.2d	Floor repair	Floor repair material will meet or exceed strength of existing floor material Repair will span from joist to joist and blocking added as needed to support floor Patches smaller than 144 square inches will not require repairs from joist to joist Floor repair material will be glued, fastened, and air sealed	Ensure floor is structurally sound Minimize air leakage
3.1301.2e	Structural materials	Materials will be selected to comply with manufactured housing rules and regulations (e.g., Manufactured Housing Institute) Materials will be used or installed in accordance with manufacturer specifications	Select materials to ensure durable and permanent repair
3.1301.2f	High temperature application	Only noncombustible materials will be used in contact with chimneys, combustion exhaust vents, and flues	Prevent a fire hazard

Bay Window

3.1302.1a	Work assessment	Installer prework assessment will be conducted to determine: <ul style="list-style-type: none"> • Accessibility • Number • Type • Size • Operating condition • Condition of opening • Wall construction type 	Ensure work space is safe and ready for air sealing Verify scope of work
3.1302.1b	Lead paint assessment	Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file EPA's Renovation, Repair and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards	Protect worker and occupant from potential lead hazards
3.1302.1c	Air infiltration	Details that reduce air infiltration will be repaired, replaced, sealed, or installed Bay window floor framing that connects interior to exterior underpinning and insulation must be removed to seal gaps, cracks, and joints Blocking must be installed on perimeter rail (rim joist) if missing Seal all gaps, cracks, and joints of all framing in bay window assembly Insulation must be replaced or installed in full contact with subfloor Underpinning will be replaced and sealed	Reduce air infiltration
3.1302.1d	Water infiltration	Details that reduce water infiltration will be repaired, replaced, or installed	Reduce water infiltration
3.1302.1e	Materials	Materials will be used or installed in accordance with product manufacturer specifications	Ensure proper use and installation of materials

Additions

3.1701.1a	Work assessment	Installer prework assessment will be conducted to determine: <ul style="list-style-type: none"> • Structural integrity • Roof leaks • Insect infestation • Accessibility • Mechanical attachment • Location of marriage wall seams • Number, type, size, and location of penetrations 	Ensure work space is safe and ready for air sealing Verify scope of work
3.1701.1b	Hole, seam, line, and penetration sealing	Marriage wall seams will be sealed continuously at walls, floors, and ceiling connection All accessible holes and penetrations in the addition envelope will be sealed Backing or infill will be provided as needed, when accessible	Minimize air leakage Maintain durability and/or flexibility Ensure sealant is effective and durable

3.1701.1c	Materials	Materials will be used or installed in accordance with product manufacturer specifications	Select materials to ensure durable and permanent repair
3.1701.1d	Addition exterior wall air sealing	All holes and penetrations on exterior surface of exterior walls will be sealed to ensure resistance to outdoor elements Intentionally ventilated walls will not be sealed at vent locations (e.g., weep holes) All holes and penetrations on the interior surface of exterior walls will be repaired Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration	Minimize air leakage Maintain durability Ensure resulting closure is permanent and supports expected wind and mechanical pressure loads Ensure sealant is effective and durable
3.1701.1e	Addition interior wall air sealing	All accessible holes and penetrations in top and bottom plates will be sealed Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration	Minimize air leakage Maintain durability Ensure resulting closure is permanent and supports expected load Ensure sealant is effective and durable
3.1701.1f	Addition floor air sealing (decking, subfloor, floor decking)	Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration The backing or infill will not bend, sag, or move once installed	Ensure resulting closure is permanent and supports expected wind and mechanical pressure loads Ensure sealant is effective and durable
3.1701.1g	Sealant selection	Sealants will be used to fill holes no larger than recommended by manufacturer specifications Sealants will be compatible with all adjoining surfaces Sealants will be continuous and meet fire barrier specifications, if required	Create a permanent seal Ensure sealant meets or exceeds the performance characteristics of the surrounding materials
3.1701.1h	Floor repair	Floor repair material will meet or exceed strength of existing floor material Repair will span from joist to joist and blocking added as needed to support floor Patches smaller than 144 square inches will not require repairs from joist to joist Floor repair material will be glued, fastened, and air sealed	Ensure floor is structurally sound Minimize air leakage
3.1701.1i	Structural materials	Materials will be used or installed in accordance with product manufacturer specifications	Select materials to ensure durable and permanent repair
3.1701.1j	Ceiling hole repair	Ceiling repair material must meet or exceed strength of existing ceiling material Ceiling repair must span from truss to truss or add blocking as needed for support The backing or infill will not bend, sag, or move once installed All accessible damaged vapor barriers will be repaired Penetrations through the air barrier must be repaired	Ensure ceiling is structurally sound Minimize air leakage Ensure closure is permanent and supports expected wind and mechanical pressure loads Ensure sealant does not fall out
3.1701.1k	High temperature application	Only noncombustible materials will be used in contact with chimneys, vents, and flues	Prevent a fire hazard

29100 Exterior Storm Windows

Exterior storm windows shall only be installed in manufactured homes over single pane, non-fixed windows. New storm windows must not be used to replace existing storms if the existing storm windows are in good condition. Metal exterior storm windows must meet with the following requirements:

- A) Storm windows shall be caulked around the frame at time of installation, except for weep holes that shall not be sealed;
- B) Storm-window sashes must be removable from indoors; and
- C) Fixed storm windows must not restrict the existing capacity and access required for emergency exits.

30000 Insulation Measures

Insulation in manufactured homes is typically inadequate to maintain either thermal comfort or energy efficiency. Due to structural limitations and manufacturing techniques, nearly all manufactured homes weatherized will require that additional insulation be added. Cellulose insulation is not approved for any insulation application in manufactured homes.

30100 Roof Cavity Insulation

Soffit-vented roof cavities shall be insulated according to Site-Built Installation Standards. Attic insulation installed in soffit-vented roof cavities must allow for attic ventilation to be maintained (the attic shall not be blown to capacity nor shall the soffit vents be filled with insulation. Unvented roof cavities in weatherized manufactured homes shall be insulated to capacity. Under no circumstances shall roof cavities be dense packed. Cellulose insulation is not a permissible material. In cases where an additional roof has been retrofitted over the original roof, only the original roof cavity shall be insulated.

Justification shall be required for any instance where roof cavity insulation could not be achieved, and such justification (including photographs) shall be maintained in the job file.

Static Electric Shock			
2.0602.1a	Rigid fill tube	Rigid fill tubes will be made of a material that will not hold an electric charge, such as Schedule 40 PVC Electrical Conduit, or be grounded	Prevent injury to the installer
2.0602.1b	Metal coupler grounding	For an additional level of protection, the metal coupler on the hose will be connected to the grounding wire Grounding wire will be connected to the grounding rod Grounding rod will be driven into the ground a minimum of 8' when possible; grounding wire will be connected in compliance with local code and authority having jurisdiction	Divert static discharge of electricity to ground instead of installer
2.0602.2a	Metal skin and frame grounding	Metal skin and frame will be grounded through the panel box to avoid electrical shock	Prevent injury to the installer
2.0602.2b	Metal fill tube grounding	For an additional level of protection, metal fill tube will be connected to the grounding wire Grounding wire will be connected to the copper grounding rod that is driven into the ground a minimum of 8' when possible and required by code or authority having jurisdiction	Divert house electric current to ground instead of installer in the event of contact with a live wire
2.0602.2c	Electrical tool safety	An electrical safety assessment will be performed All electric tools will be protected by ground-fault circuit interrupters (GFCI) Three-wire type extension cords will be used with portable electric	Avoid electrical shock and arc flash hazards
2.0602.2d	Aluminum wiring	If aluminum wiring is present, work on the home will be stopped until the suspect wiring is inspected and determined to be safe by a licensed electrician After energy retrofit is completed, wiring will be reinspected by a licensed electrician	Prevent injury to installer and occupant Prevent damage to structure

30110 Pre-Roof Cavity Insulation Inspection and Preparation

Roof cavities shall be inspected to determine the amount of existing insulation, if any, and to note any structural problems by drilling inspection holes in inconspicuous locations. Plastic plugs shall be used to repair the drill holes created during interior inspection. The client's written consent must be secured prior to drilling any inspection holes into the manufactured home. Exterior inspection holes are also permissible, but may only be drilled if the auditor has the appropriate materials to either reseal the roof or patch the inspection hole.

The electrical wiring shall be inspected to confirm that wiring is not cracked, blistered, or deteriorated and that circuits show no evidence of overloading. The client shall be asked about any known existing electrical problems.

Metal roofs shall be cleaned of dirt, leaves, and loose roofing material.

30120 General Roof Cavity Insulation Guidelines

There are three typical types of manufactured home roofs: bowstring, flat, and peaked. Each type of roof has at least two acceptable methods for insulating. Polyvinyl Chloride (PVC) pipe creates static electricity and, therefore, shall not be used as an extension for the purposes of blown insulation. Rigid extension pipes of other materials, such as a painter's extension pole, may be attached to the side of the insulation hose.

In the case of sloped or vaulted ceilings, a combination of these methods may be needed and is allowed. Insulating from the interior of the manufactured home is not recommended, but is allowable. Plastic plugs are available to repair the holes drilled in the ceiling if this method becomes necessary.

Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Roof Side Lift)			
4.1003.8a	Attic, ceiling, and roof verification	<p>All combustion appliance flues will be terminated to the outdoors and terminations will maintain proper clearance above snow loads</p> <p>A distance no less than 2" will be maintained between any combustion appliance flue and combustible materials, unless zero clearance flue is in place</p> <p>All ventilation systems will maintain a continuous connection and terminate to the outdoors</p> <p>All broken mushroom vents will be replaced or removed and sealed</p> <p>All plumbing stacks will be terminated to the outdoors</p> <p>Non-IC rated light fixtures will be replaced with airtight IC-rated fixtures</p> <p>All recessed lights will be labeled as having an air leakage rate no more than 2.0 CFM when tested in accordance with ASTM E 283 at a 75 pascals pressure differential</p> <p>All obvious ceiling penetrations will be sealed</p> <p>The space between combustion appliance flues and the ceiling will be sealed with fire-rated materials</p> <p>All roof, attic, and ceiling assemblies will be structurally sound; loose ceiling panels will be secured</p> <p>Temporary ceiling bracing will be recommended during the insulation installation process</p> <p>Dishing and pooling issues that allow standing water will be addressed</p> <p>All known roof water leaks will be repaired before insulation installation</p>	<p>Ensure occupant and worker safety</p> <p>Verify attic space is ready to insulate</p> <p>Ensure structural integrity of the roof and ceiling assembly</p> <p>Prevent intrusion of bulk moisture</p> <p>Prevent damage during the insulation installation process</p>

4.1003.8b	Attic access	<p>Fasteners will be removed from the J channel and the roof edge on the most easily accessible side of the house</p> <p>Roof will be separated from the heel plate and siding roof will be lifted and propped to accommodate fill tube</p> <p>Length of opening will be enough to allow ease of access and reattachment while minimizing potential damage from high winds</p> <p>If subsheathing is present, access will be gained through subsheathing</p> <p>Attic will be visually inspected for the location of existing insulation, obstructions, hazards, and construction type</p>	<p>Create access to the full attic cavity</p> <p>Protect roof from wind damage during installation</p> <p>Ensure ease of roof reattachment</p> <p>Determine insulation installation technique</p>
4.1003.8c	Blowing machine set up	<p>Blowing machine pressure test will be performed with air on full, feed off, and gate closed</p> <p>Hose outlet pressure will be set in accordance with manufacturer specifications</p>	<p>Ensure machine is capable of delivering uniform insulation density and coverage</p>
4.1003.8d	Fiberglass blown insulation installation	<p>Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot</p> <p>Using fill tube, 100% of each cavity will be filled to a consistent density Fill tube will be inserted within 6" of the end of each attic cavity Insulation will be installed into the void of the attic cavity:</p> <ul style="list-style-type: none"> • If existing insulation is roof-mounted, insulation will be blown below • If existing insulation is ceiling-mounted, insulation will be blown above • If existing insulation is mounted at both locations, insulation will be blown in between <p>Avoid overfilling of roof edges and above attic trusses</p> <p>Flame spread and smoke-developed index for insulation will be a flame spread rating of 25 or less and a smoke development rating of 450 or less when tested in accordance with ASTM E84</p>	<p>Fill entire attic cavity to the prescribed R-value to reduce air infiltration</p> <p>Avoid clogging of the cavity and the fill tube</p> <p>Prevent damage to the ceiling</p> <p>Allow roof to be returned to original position</p> <p>Fire safety will be maintained</p>
4.1003.8e	Roof reattachment	<p>If existing J channel is damaged, it will be replaced</p> <p>Existing sealant will be removed from the roof edge and J channel</p> <p>At a minimum, new sealant will be reinstalled at the original location</p> <p>Roof and J channel will be fastened to the original location with new screws</p> <p>All seams, edges, and penetrations will be sealed as necessary</p>	<p>Prepare roof edge and J channel for reattachment</p> <p>Reattach roof edge and J channel without leaks</p>
4.1003.8f	Verification of details	<p>Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process</p>	<p>Verify the integrity of the house has been maintained</p>

30121 Roof Cavity Fill Method

The following procedure is appropriate for metal unvented manufactured home roof types. Sloped or vaulted roofs may also be insulated using this method. This method shall not be used in vented roof cavities.

- A) Cut 10 in.² holes in the roof on one or both sides of the ridge vent, or peak of the roof, above every second truss. Each hole should be able to access two truss cavities simultaneously.
- B) Insert a fill hose that is 2-2 ¼ in. in diameter and tapered to a 45° angle into the access hole toward the edge of the roof cavity and insulate to capacity, moving the hose in all four horizontal directions. As the cavity is filled, the insulation should “push” the hose back toward the installer, indicating that the cavity is sufficiently insulated.
- C) Patch the roof using a 14 in.² stiff, galvanized steel patch screwed into the existing roof with hex-head screws set every 2 in. and place the silicone sealant so that it is squeezed between the roof and the patch. Then add more across the seam of the edge. It may be necessary to clean around the access holes to ensure proper adhesion.
- D) Cover the first galvanized steel patch with an 18 in.² patch consisting of foil-faced butyl rubber. In colder temperatures, it may be necessary to heat this patch around the edges to ensure proper adhesion.
- E) The entire roof shall be carefully inspected and all potential leak sites shall be patched and coated as needed to protect against moisture issues, such as wet insulation.

The following procedure is appropriate for shingled unvented manufactured home roof types.

- A) The shingles shall be removed with a flat bar and reused if possible. If new shingles must be purchased for replacement a similar type and color will be secured. The owner must authorize the use of similar shingles before weatherization work begins.
- B) Cut 10 in.² holes in roof on one or both sides of the ridge vent, or peak of the roof above every second truss. Each hole should be able to access two truss cavities simultaneously. If a ridge cap is present, it may be used for access instead of cutting access holes.
- C) Insert a fill hose that is 2-2 ¼ in.² in diameter and tapered to a 45° angle into the access hole toward the edge of the roof cavity and insulate to capacity, moving the hose in all four horizontal directions. As the cavity is filled, the insulation should “push” the hose back toward the installer, indicating that the cavity is being sufficiently insulated. Existing roof vents may be used in lieu of cutting new access holes to apply insulation; however, additional roof or vent caps shall not be added as an alternative to sealing roof patches after insulating.
- D) Cut holes shall be plugged with a material similar to the roof deck. The plug shall be sealed prior to reinstalling the shingles.

Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Exterior Access from Top of Roof)			
4.1003.9a	Attic, ceiling, and roof verification	<p>All combustion appliance flues will be terminated to the outdoors and terminations will maintain proper clearance above snow loads</p> <p>A distance no less than 2" will be maintained between any combustion appliance flue and combustible materials, unless zero clearance flue is in place</p> <p>All ventilation systems will maintain a continuous connection and terminate to the outdoors</p> <p>All broken mushroom vents will be replaced or removed and sealed</p> <p>All plumbing stacks will be terminated to the outdoors</p> <p>Non-IC rated light fixtures will be replaced with airtight IC-rated fixtures</p> <p>All recessed lights will be labeled as having an air leakage rate not more than 2.0 CFM when tested in accordance with ASTM E 283 at a 75 pascals pressure differential</p> <p>All obvious ceiling penetrations will be sealed</p> <p>The space between combustion appliance flues and the ceiling will be sealed with fire-rated materials</p> <p>All roof, attic, and ceiling assemblies will be structurally sound:</p> <ul style="list-style-type: none"> • Loose ceiling panels will be secured • Temporary ceiling bracing will be recommended during the insulation installation process <p>Dishing and pooling issues that allow standing water will be addressed</p> <p>All known roof water leaks will be repaired before installing installation</p>	<p>Ensure occupant and worker safety</p> <p>Verify attic space is ready to insulate</p> <p>Ensure structural integrity of the roof and ceiling assembly</p> <p>Prevent intrusion of bulk moisture</p> <p>Prevent damage while installing insulation</p>
4.1003.9b	Attic access	<p>Access to the attic cavity will be created using one of these methods:</p> <ul style="list-style-type: none"> • Drilling • Cutting • Continuous slicing along the center line (at the highest point of the roof) <p>Access location will be placed to allow for consistent and uniform coverage of installed insulation throughout the attic assembly</p> <p>There will be, at a minimum, one opening between each roof truss</p> <p>Openings will be large enough to accommodate the chosen fill tube</p> <p>If subsheathing is present, access will be gained through subsheathing</p> <p>Attic will be visually inspected for the location of existing insulation, wiring, flues, obstructions, hazards, and construction type</p>	<p>Create access to the full attic cavity</p> <p>Maintain the integrity of the roof truss</p> <p>Protect roof from wind damage during installation</p> <p>Determine technique for installing insulation</p>
4.1003.9c	Blowing machine set up	<p>Blowing machine pressure test will be performed with air on full, feed off, and gate closed</p> <p>Hose outlet pressure will be set in accordance with manufacturer specifications</p>	<p>Ensure machine is capable of delivering uniform insulation density and coverage</p>

4.1003.9d	Fiberglass blown insulation installation	<p>Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot</p> <p>Using fill tube, 100% of each cavity will be filled to a consistent density Fill tube will be inserted within 6" of the end of each attic cavity Insulation will be installed into the void of the attic cavity:</p> <ul style="list-style-type: none"> • If existing insulation is roof-mounted, insulation will be blown below • If existing insulation is ceiling-mounted, insulation will be blown above • If existing insulation is mounted at both locations, insulation will be blown in between <p>Insulation will be filled no higher than the top of the truss</p> <p>Flame spread and smoke-developed index for insulation will be a flame spread rating of 25 or less and a smoke development rating of 450 or less when tested in accordance with ASTM E84</p>	<p>Fill entire attic cavity to the prescribed R-value to reduce air infiltration</p> <p>Avoid clogging of the cavity and the fill tube</p> <p>Prevent damage to the ceiling</p> <p>Allow roof to be returned to original position</p> <p>Fire safety will be maintained</p>
4.1003.9e	Patching and sealing openings	<p>If the roof is sliced:</p> <ul style="list-style-type: none"> • A solid metal ridge cap will be centered over the slice • A flexible and durable sealant will be sandwiched between the roof and the ridge cap • Screws will be installed to prevent wrinkles and create a permanent seal • Screws will not go into any wood framing • A durable and flexible final coating will be applied over the screws and edge of the ridge cap to create a continuous seal between the roof and the perimeter of the ridge cap <p>For holes that are drilled or cut, the initial patch will be applied using the following procedure:</p> <ul style="list-style-type: none"> • At least 6" of surface surrounding the opening will be cleaned before patch is installed • Sealant will be continuous and applied in between the patch and the roof • Sealant will be an all-weather adhesive that is flexible and durable <p>If a metal patch is used:</p> <ul style="list-style-type: none"> • Patch will overlap the opening by 2" on all sides • Gauge will be equal to or greater than the roof material • Fasteners will be installed to prevent wrinkles and create a permanent seal • If a plug is used, it will be flanged and have a tight fit • Screws will not go into any wood framing <p>A durable and flexible 45 mil adhesive patch will be applied in accordance to manufacturer specifications over the initial patch and will have at a minimum:</p> <ul style="list-style-type: none"> • Tear strength of 640g • Elongation of 380% • Application temperature no lower than 55°F and no greater than 110°F • Services temperature no less than -25°F and no greater than 150°F • Adhesive patch will overlap the initial patch by 2" on all sides • A durable and flexible final coating will be applied over the adhesive patch to create a continuous seal between the roof and the perimeter of the patch • All remaining seams, edges, and penetrations will be sealed as necessary 	<p>Effectively patch and seal all openings</p> <p>Create a durable patch that will prevent roof leaks</p>
4.1003.9f	Verification of details	<p>Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process</p>	<p>Verify the integrity of the house has been maintained</p>

30122 Side Lift Method

The following procedure is appropriate for metal unvented manufactured home roof types. Sloped or vaulted roofs may also be insulated using this method.

- A) Remove the J-channel guttering along the edge of the roofline along with any staples and putty tape.
- B) Pry up the roof enough to accommodate a 45° angled 10-14 ft. rigid hose extension. The roof can be propped open while insulating with a small section of pipe or lumber. Work in small 6-8 ft. sections.
- C) The extension should be inserted as close to center of roof cavity as possible and filled to capacity. As cavity is filled, insulation should “push” the hose back toward the installer, indicating that cavity is being sufficiently insulated. Ensure that the cavity is not overfilled.
- D) Reattach the lip of the roof and use self-tapping aluminum hex head screws and butyl putty tape to secure and seal the J-channel gutter.

30123 Gable End Method

The following procedure is appropriate for metal unvented manufactured home bowstring and peaked roof types. This method is best used in combination with other methods, as it may not be possible to insulate the entire length of the manufactured home from the ends.

- A) Remove the gable vents or the entire gable end siding.
- B) Attach a 45° angled 10-14 ft. rigid extension to the end of the insulation hose and insert it into the manufactured home roof cavity, taking care to insulate around and under any structural beams or obstructions and to fill it to capacity.
- C) Reinstall the gable end vents or siding.

Flat and Cathedral ceiling transition wall			
4.1088.6a	Insulation installation verification	A visual inspection of the highest point of the transition wall will be completed Access points will be determined from the gable end, roof, ceiling, or interior paneling	Verify the height and the accessibility of the attic
4.1088.6b	Access attic	Attic will be accessed through the location that allows the most efficient and effective insulation coverage	Gain access to the flat and cathedral ceiling transition wall
4.1088.6c	Blowing	Blowing machine pressure test will be performed with air on full, feed off, and gate closed Insulation will be blown against the transition wall until the wall is covered	Ensure machine is capable of delivering uniform insulation density and coverage to meet manufacturer specifications for loose blown insulation Create a thermal barrier at the transition wall
4.1088.6d	Spray two-part foam	Insulation will be installed to prescribed R-value in accordance with manufacturer specifications Spray polyurethane foam (SPF) will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer	Insulate and seal transition wall

4.1088.6e	Batt	Batt insulation will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions Insulation will be installed to the prescribed R-value Vapor barrier will be installed based on regional considerations	Insulate to prescribed R-value
4.1088.6f	Patching and sealing access points	Created access points will be covered and sealed in an aesthetically pleasing manner Existing access points (e.g., gable vent) will be returned to the original condition If existing trim was removed, it will be reinstalled	Create an airtight seal Create an aesthetically pleasing finish
4.1088.6g	Verification of details	Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process	Verify the integrity of the house has been maintained

Interior Installation Method			
4.1003.10a	Attic, ceiling, and roof verification	All combustion appliance flues will be terminated to the exterior of the house and terminations will maintain proper clearance above snow loads A distance no less than 2" will be maintained between any combustion appliance flue and combustible materials, unless zero clearance flue is in place	Ensure occupant and worker safety Verify attic space is ready to insulate Ensure structural integrity of the roof and ceiling assembly
4.1003.10b	Construction prep	Special precautions will be taken to limit fiberglass and construction dust exposure to the occupant and occupant belongings	Protect occupant health and safety Protect occupant belongings
4.1003.10c	Attic access	Equidistant holes will be drilled in a straight row parallel to the longitudinal exterior wall of the ceiling If a longitudinal ceiling trim piece exists, trim piece will be removed and holes will be drilled behind the trim	Create access to the full attic cavity Determine insulation installation technique Prevent damage to ceiling
4.1003.10d	Blowing machine set up	Blowing machine pressure test will be performed with air on full, feed off, and gate closed Hose outlet pressure will be set in accordance with manufacturer specifications	Ensure machine is capable of delivering uniform insulation density and coverage
4.1003.10e	Fiberglass blown insulation installation	Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot Using fill tube, 100% of each cavity will be filled to a consistent density Fill tube will be inserted within 6" of the end of each attic cavity Insulation will be installed into the void of the attic cavity: <ul style="list-style-type: none"> If existing insulation is roof-mounted, insulation will be blown below If existing insulation is ceiling-mounted, insulation will be blown above If existing insulation is mounted at both locations, insulation will be blown in between Flame spread and smoke-developed index for insulation will be a flame spread rating of 25 or less and a smoke development rating of 450 or less when tested in accordance with ASTM E84	Fill entire attic cavity to the prescribed R-value to reduce air infiltration Avoid clogging of the cavity and the fill tube Prevent damage to the ceiling Fire safety will be maintained
4.1003.10f	Patching and sealing holes	Holes will be plugged or covered and sealed to be aesthetically pleasing If existing trim was removed, it will be reinstalled	Create an airtight seal Create a visually acceptable ceiling finish

4.1003.10g	Verification of details	Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process	Verify the integrity of the house has been maintained
4.1003.10a	Attic, ceiling, and roof verification	<p>All combustion appliance flues will be terminated to the exterior of the house and terminations will maintain proper clearance above snow loads</p> <p>A distance no less than 2" will be maintained between any combustion appliance flue and combustible materials, unless zero clearance flue is in place</p> <p>All ventilation systems will maintain a continuous connection and terminate to the outdoors</p> <p>All broken mushroom vents will be replaced or removed and sealed</p> <p>All plumbing stacks will be terminated to the outdoors</p> <p>Non-IC rated light fixtures will be replaced with airtight IC-rated fixtures, if feasible and only when installed measures will compromise the fire rating of the fixture</p> <p>All recessed lights will be labeled as having an air leakage rate no more than 2.0 CFM when tested in accordance with ASTM E 283 at a 75 pascals pressure differential</p> <p>All obvious ceiling penetrations will be sealed</p> <p>The space between combustion appliance flues and the ceiling will be sealed with fire-rated materials</p> <p>All roof, attic, and ceiling assemblies will be structurally sound:</p> <ul style="list-style-type: none"> • Loose ceiling panels will be secured • Temporary ceiling bracing will be recommended while installing installation <p>Dishing and pooling issues that allow standing water will be addressed</p>	<p>Ensure occupant and worker safety</p> <p>Verify attic space is ready to insulate</p> <p>Ensure structural integrity of the roof and ceiling assembly</p> <p>Prevent intrusion of bulk moisture</p> <p>Prevent damage while installing insulation</p>
4.1003.10b	Construction prep	Special precautions will be taken to limit fiberglass and construction dust exposure to the occupant and occupant belongings	<p>Protect occupant health and safety</p> <p>Protect occupant belongings</p>
4.1003.10c	Attic access	<p>Equidistant holes will be drilled in a straight row parallel to the longitudinal exterior wall of the ceiling</p> <p>If a longitudinal ceiling trim piece exists, trim piece will be removed and holes will be drilled behind the trim</p> <p>Hole location and size will be placed to provide access to allow for consistent and uniform coverage of installed insulation throughout the attic assembly</p> <p>There will be, at a minimum, one hole between each roof truss</p> <p>Holes will be large enough to accommodate the chosen fill tube without damaging the ceiling material during installation</p> <p>If a vapor barrier or ceiling-mounted insulation is present, access will be gained through them</p> <p>Attic will be visually inspected for the location of existing insulation, obstructions, hazards, and construction type</p>	<p>Create access to the full attic cavity</p> <p>Determine insulation installation technique</p> <p>Prevent damage to ceiling</p> <p>Create a professionally finished ceiling</p>

Roof over construction			
4.1003.11a	Roof-over overview	<p>If occupant will allow access from interior, installation through the ceiling is preferred</p> <p>Attic space created by the roof-over will be accessed in accordance with the Single-Family Attic Access SWS</p> <p>If the roof-over does not allow physical access to the roof-over attic, access to the original attic will be gained through roof venting</p> <p>If existing insulation height in the attic is less than the height of the heel plate (original attic), access will be made through the original roof and the original attic cavities will be filled before blowing insulation over the original roof</p> <p>At a minimum, the access holes to the original attic cavities will be sealed to prevent air leakage</p> <p>If existing insulation height is equal to or greater than the height of the heel plate (original attic), the insulation will be installed in the end cavities before blowing on top of the original roof</p> <p>Access to the end cavities will be gained and insulation will be installed</p> <p>At a minimum, the access holes to the original attic cavities will be sealed to prevent air leakage</p> <p>Insulation will not be installed on top of the original roof until the end cavities are insulated and air sealed in original attic</p> <p>If insulation is installed on top of the original roof, it will be installed in accordance with the Single-Family SWS Loose Fill Blown Fiberglass Insulation Installation</p>	<p>Gain access to the combined attic spaces</p> <p>Address thermal bridging</p> <p>Correctly insulate the combined attic spaces</p>

30130 Cool Sealing

Cool roof coatings are an allowable measure as they can reduce cooling costs as well as providing additional moisture protection for the installed roof cavity insulation. The cool roof coating shall be an Energy Star®-qualified elastomeric material. Application should follow the manufacturer's recommendation. Preparation for the cool sealing shall include the following:

- A) Sand any rusted areas down to sound metal. If the rusted areas are greater than 30% of the roof or if the rusted through areas are greater than 5%, the manufactured home must be deferred.
- B) Reinforce any open joints around skylights, pipe flashings, roof drains, and wall transitions with a mesh roof fabric and roof coating. Dip the fabric patches in the roof coating and spread them over the existing roof or lay dry fabric onto a layer of wet coating on the roof. Smooth the patch down with a broad knife or squeegee to remove any wrinkles or bubbles and allow at least 24 hours for curing before applying the coating.
- C) Protect windows, siding, and vehicles from splatters and overspray.

Reflective Coatings on Metal Roofs			
5.3202.1a	Assessment	Existing roof coating will be assessed for hazardous material	Ensure worker and occupant safety
5.3202.1b	Preparation	<p>Roof will be stripped of all debris, algae, and peeled and loose coating</p> <p>Repairs to roof and penetrations will be made before application</p>	Ensure roof is clean, dry, and structurally sound for proper adhesion of new coating

5.3202.1c	Materials selection	Material will be approved for application to metal and existing roof coating Material will be an ENERGY STAR qualified reflective coating Roof coating will be durable, flexible, reflective, and meet ASTM D412, ASTM D1737, and UL 790 Class A	Provide proper reflective coating
5.3202.1d	Application	Roof-coating material will be applied in accordance with manufacturer specifications	Ensure proper application
5.3202.1e	Occupant education	Occupant will be educated on the maintenance of reflective coating per manufacturer specifications, including annual	Preserve integrity and effectiveness of reflective coating

30200 Belly Insulation

The belly cavity shall be filled to capacity regardless of existing insulation value. Belly cavities shall be secured, with 1 in. by 1 in. furring strips if necessary, to hang no lower than 24 inches below the subfloor and shall be blown to resistance, and not dense-packed. Installation of batt insulation is not allowable.

30210 Pre-Belly Insulation Inspection Preparations

Carefully inspect the interior of the manufactured home prior to insulating in order to prevent infiltration of belly insulation into the interior of the dwelling. Ensure that all appropriate air sealing and duct sealing has been performed. Secure all ducts and water piping to the floor where possible. Address any missing or deteriorated belly liner and belly board as follows:

- A) Holes in the belly liner up to 24 in. in diameter shall be patched using a self-adhesive belly patch (e.g. *Flex-mend*) and shall be reinforced with stitch (or butterfly) staples.
- B) Holes in the belly liner that are 24 in. and larger in diameter shall be patched with replacement belly fabric and with stitch staples and shall be covered with adhesive belly repair material with a minimum overlap width of 4 in. Stitch staples alone are not adequate, as they can fail once the belly liner has been properly insulated to capacity.
- C) For a severely deteriorated belly liner, full replacement may be warranted. Replacement shall proceed as follows:
 - a) remove the remains of the old liner.
 - b) fasten the house wrap between the center I-beams with staples along the length of the home, ensuring that the liner is fitted securely around penetrations and appropriately sealed.
 - c) reinforce with furring or lathe strips screwed into the bottom of the floor joists every 10-15 ft., or as the manufactured home condition warrants. This shall be done with care to avoid damaging the duct trunk line and water lines in the belly.

Rigid board insulation shall be used for patching or otherwise repairing the wings on either side of the manufactured home, but it is not recommended for the larger center section due to the larger area and lack of support beams.

30220 Belly Insulation Installation Requirements

- A) Cut holes in each outer rigger and in the center between the I-beams. Center the holes for the outer rigger between the outer rim joists.
- B) Insert a 45° angled 10-14 ft. rigid extended insulation hose and blow insulation to resistance.
- C) Patch holes as instructed in chapter 26210 of the Manufactured Home Installation Standards.

Insulation of Floor Cavity with Blown Material			
4.1303.1a	R-value	Insulation will be installed in accordance with recommended R-value and density	Insulate to prescribed R-value for the climate zone
4.1303.1b	Work assessment	Road and rodent barrier must be intact and free from holes and capable of supporting the insulation	Ensure bottom board is intact Ensure insulation is supported Protect cavity from infestation
4.1303.1c	Insulate floors	Each cavity will be insulated to specified R-value and density The number of bags installed will be confirmed and will match the number required on the coverage chart	Eliminate voids and settling
4.1303.1d	Materials	Flame spread index of selected materials will not exceed 25 with an accompanying smoke-developed index not to exceed 450 when tested in accordance with ASTM E84 or UL 723 Flame spread index of foam insulation will not exceed 75 and a smoke-developed index of no more than 450 when tested in the maximum thickness intended for use in accordance with ASTM E84 or UL 723 Foam insulation will be separated from the interior of the building by an approved thermal barrier at a minimum of 1/2" gypsum or a material that is tested in accordance with the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275 Selected material will be of minimal water absorbency	Ensure durability Prevent moisture damage Fire safety will be maintained
4.1303.1e	Occupant education	Documentation of material and R-value will be provided to occupant	Provide occupant with documentation of installation

Prepare Belly Floor Cavity for Insulation			
4.1302.1a	Work assessment	Gas, water, waste, and electrical lines will be checked for: <ul style="list-style-type: none"> • Plumbing leaks • Gas/oil leaks • Attachment • Standing water • Raw sewage • Pests 	Ensure that floor space is safe and ready for work Verify scope of work

4.1302.1b	Preparation	<p>Where bottom board/rodent barrier is missing or damaged and accessible, the following will be ensured:</p> <ul style="list-style-type: none"> • Duct sealing completed • Gas, water, and electrical lines secured at least every 4' to a floor joist or framing member • Water line will be located on the warm side of the insulation; if not, the water lines will be insulated appropriately • No water or gas leaks are present • Waste lines are sloped to ¼" per foot • Bottom board/rodent barrier is sound/strong enough to support insulation <p>When bottom board is intact, the following will be ensured:</p> <ul style="list-style-type: none"> • Holes and penetrations in the bottom board and decking sealed • Duct sealing completed • No water or gas leaks present • Bottom board is sound/strong enough to support insulation • Water lines are secured to the floor joists/warm side of the insulation; if not, the water lines will be insulated appropriately <p>Problems will be corrected before floor cavity insulation work begins</p>	<p>Ensure problems are corrected before floor cavity insulation work begins</p> <p>Keep pipes from freezing</p>
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Insulation of Floor Cavity with Batt Material			
4.1303.2a	R-value	Insulation will be installed in accordance with recommended R-value and density	Insulate to prescribed R-value for the climate zone
4.1303.2b	Work assessment	<p>Ensure complete accessibility of floor cavity</p> <p>Clean floor cavities</p> <p>Remove all remnants of previous insulation and bottom board</p>	Ensure work area is clean, safe, and ready to accept insulation
4.1303.2c	Insulate floors	<p>Each cavity will be insulated to specified R-value and density</p> <p>If insulation has facing, facing will be in contact with the heated side</p> <p>Insulation will be in contact with subfloor</p> <p>Insulation will not have gaps, voids, or be compressed</p> <p>Insulation will be supported (e.g., metal insulation supports) to maintain a permanent contact with subfloor</p> <p>Insulation will be notched around all wires, pipes, and blocks</p> <p>Ducts and water lines will be insulated for climate conditions</p> <p>Water lines will be located above the warm side of the insulation (toward the conditioned space), when feasible</p> <p>A rigid air barrier will be installed in contact with the bottom of the joists, when feasible</p> <p>Rigid air barrier will be fastened as to not sag, bend, or fall off</p> <p>Seams, holes, and joints in the air barrier will be sealed</p> <p>In cases where HVAC ducts hang below the level of the rigid air barrier and insulation, the ducts will be insulated and air barrier provided that is sealed to the rigid air barrier</p>	<p>Eliminate voids</p> <p>Minimize conductive heat transfer across the floor system</p> <p>Ensure durability</p> <p>Minimize convective heat transfer</p> <p>Keep pipes from freezing</p>
4.1303.2d	Materials	<p>Insulation materials will be of minimal water absorbency and flame spread, and smoke-developed index for insulation will be in accordance with 2012 IRC 2012, Sections R302.10.1 through R302.10.5</p> <p>Foam plastic insulation will comply with 2012 IRC 2012, Section R316</p>	<p>Ensure durability</p> <p>Prevent moisture damage</p>
4.1303.2e	Occupant education	Documentation of material and R-value will be provided to occupant	Provide occupant with documentation of installation

30230 Belly Insulation Protection

Replacement or installation of manufactured home skirting in order to protect weatherization measures from pests is not an allowable expense. The use of chicken wire around the perimeter is allowed for this purpose where no barrier exists, provided this measure does not constitute code violation in the applicable city or county.

Bottom Board			
3.1301.1a	Work assessment	Installer prework assessment will be conducted to determine: <ul style="list-style-type: none"> • Structural integrity • Standing water • Raw sewage • Insect infestation • Pests • Accessibility • Number, type, size, and location of penetrations 	Ensure work space is safe and ready for air sealing Verify scope of work
3.1301.1b	Soft bottom board repair	Patching material will be provided as needed to meet the specific characteristics of the bottom board material and the characteristics of the hole Patch will have a service life of a minimum of 20 years	Minimize air leakage Keep insulation in place Ensure repair materials are compatible Ensure patch will support insulation
3.1301.1c	Hard bottom board repair	Patching will be provided as needed to meet both the specific characteristics of the bottom board material and the characteristics of the hole Patch will not bend, sag, or move once installed Patch will be permanent	Minimize air leakage Ensure repair materials are compatible Minimize hole size to ensure successful use of sealant Ensure closure is permanent and supports insulation Ensure sealant does not fall out
3.1301.1d	Bottom board penetrations	Combustion air supplies will be labeled for identification and will not be blocked or sealed Penetrations will be sealed to meet both the specific characteristics of the bottom board material and the characteristics (hole size and type) of the penetrations (e.g., electrical, PVC, gas line, dryer vent) The patch will not bend, sag, or move once installed	Ensure combustion equipment is not compromised Minimize air leakage around penetrations
3.1301.1e	Materials	Materials will be selected to comply with manufactured housing rules and regulations (e.g., Manufactured Housing Institute) Surface preparation and material selected will be used or installed in accordance with product manufacturer specifications	Select materials to ensure durable and permanent repair

30300 Sidewall Insulation

Sidewalls shall be insulated provided there is more than 1 in. of depth in a wall that has no insulation and an area equal to one long wall (excluding doors and windows) can be insulated. Due to the structural limitations of manufactured home walls, blown insulation shall not be allowed. Only high-density, unfaced, R-13 fiberglass batt insulation shall be installed.

30310 Pre Sidewall Insulation Inspections & Preparation

Inspect all interior walls for holes and seal them prior to insulating. Weak or damaged walls shall be reinforced or repaired prior to insulating. Inspect walls to detect blocking which may impede sidewall insulation stuffing.

30320 Sidewall Insulation Guidelines

1. Open the siding at the band joist by removing the fastening screws from the bottom of the wall panels. It may also be necessary to remove staples with a long pry bare from underneath the wall panels. If the manufactured home is partially insulated, pull out the existing insulation before installing new batts.
2. Stuff the un-faced insulation into the cavity using a ¼ in. polycarbonate sheet or a galvanized stuffing tool of appropriate width and length to safely stuff the batt insulation into the cavity. Polycarbonate may be heated to create a 5° bend, 12 in. from one end, which can ease installation of the insulation past obstructions.
3. Repeat Steps 1. and 2. for all wall cavities and refasten the siding.

Stuffing Wall Cavities with Fiberglass Batts			
4.1104.1a	Access wall cavities	<p>If skirting overlaps siding, skirting will be detached to allow access to the wall cavity</p> <p>Fasteners will be removed from the bottom of the siding, working upward until the siding can be pulled away from the framing approximately 6" without damaging the siding</p> <p>Temporary fasteners will be installed near the bottom of the siding panels at the seams to prevent separation</p> <p>If a subsheathing is present under the siding, access through the subsheathing will be required</p>	Gain access to the wall cavity without damaging or separating the siding
4.1104.1b	Exterior wall cavity inspection	<p>Wall cavities will be inspected for moisture damage, pest locations, and integrity of the wiring, and holes to the interior</p> <p>Siding will be repaired as necessary</p> <p>Location of belt rails, obstructions, and existing insulation will be identified</p> <p>All interior surfaces of exterior walls will be inspected for loose paneling joints, occupant wall hangings, location of switches and outlets, and other wall obstructions</p> <p>Objects will be removed from the interior surfaces of the walls being insulated</p> <p>Interior paneling will be repaired as necessary</p>	<p>Prepare wall cavity for insulation</p> <p>Prevent water leaks from occurring</p>
4.1104.1c	Fiberglass batt installation tool (stuffer)	<p>A sheet of polycarbonate, such as Lexan, will be cut to the following specifications to create a stuffer tool:</p> <ul style="list-style-type: none"> • Approximately 1' x 8' x ¼" with a 5 degree bend 7' ½" from the bottom • All corners of the Lexan (polycarbonate) will be rounded and all edges will be sanded <p>Other clear sheet plastics will not be used due to a tendency to shatter under stress</p>	<p>Create a tool to install a fiberglass batt into the cavity</p> <p>Ensure worker safety</p>

4.1104.1d	Fiberglass batt installation	<p>Thickness of the batt will fill the void without deforming siding or damaging structure</p> <p>Fiberglass batts will fill the cavity (e.g., batt may be cut approximately 1" longer to ensure proper fill and allow for lap at the top)</p> <p>Flexible membrane will have an appropriate perm rating for the region</p> <p>Flexible membrane will be cut 2" wider than the cavity and approximately 1' longer than the batt</p> <p>Stuffer tool, membrane, and fiberglass batt will be aligned for installation</p> <p>Stuffer tool will be used to install the fiberglass batt and membrane at the same time</p> <p>Excess fiberglass batt and membrane vapor retarder extending below the cavity will be rolled and tucked into the cavity</p> <p>A poly-encased fiberglass batt may be used in place of the fiberglass batt and membrane assembly</p> <p>The membrane will be installed in contact with the side of the wall that is compatible with the local climate zone</p>	<p>Maintain integrity of the batt</p> <p>Aid in the installation process</p>
4.1104.1e	Sub-sheathing patch and repair	Subsheathing will be patched or repaired as necessary	Ensure the integrity of the drainage plane
4.1104.1f	Reattachment	<p>If skirting was removed, skirting will be reinstalled to shed water to the outside of the skirting</p> <p>Siding will be reattached with new fasteners</p> <p>Siding will be reattached without bulges or wrinkles</p>	<p>Ensure the integrity of the drainage plane</p> <p>Return siding to existing conditions without damage</p>

31000 Base Load Reductions

31100 Water Heater Reduction Measures

Water heaters located in exterior closets shall have ZPDs taken to determine if the closet should be considered outside or inside the conditioned space. If it is determined to be outside, all wall surfaces between the closet and the inside shall be insulated and air sealed. If it is determined to be inside, only the exterior access door shall be insulated. Fuel-fired water heaters located in manufactured homes must be sealed combustion.

32000 – Incidental Repairs – Manufactured Homes

Manufactured Housing Windows and Doors			
3.1201.5a	Work assessment	Installer prework assessment will be conducted to determine: <ul style="list-style-type: none"> • Number • Type • Operating condition • Wall construction 	Ensure work space is safe and ready for air sealing Verify scope of work
3.1201.5b	Lead paint assessment	Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file EPA's Renovation, Repair and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards	Protect worker and occupant from potential lead hazards
3.1201.5c	Operable windows and doors	All egress windows will be operable as required by local codes All egress doors will be operable as required by local codes	Maintain operability of egress windows and doors
3.1201.5d	Air infiltration	Details that reduce air infiltration will be repaired, replaced, sealed, or installed (e.g., plastic gliders, weatherstripping, cranks, latches, locks, knobs, thresholds)	Reduce air infiltration
3.1201.5e	Water infiltration	Details that reduce water infiltration will be repaired, replaced, or installed (e.g., replace missing glazing on sash, exterior caulking, exterior storm windows, storm doors, drip cap, J-channel, flashing)	Reduce water infiltration
3.1201.5f	Materials	Materials will be used or installed in accordance with product manufacturer specifications	Select materials to ensure durable and permanent repair
3.1201.5g	Quality assurance	Windows and doors will be adjusted to properly fit the jamb and allow for ease of operation and security	Ensure proper operation of the window, door, and hardware
3.1201.5h	Occupant education and maintenance	Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain windows and doors	Ensure long-term weathertightness

Repairing Windows			
3.1202.3a	Work assessment	Installer prework assessment will be conducted to determine: <ul style="list-style-type: none"> • Number • Type • Location • Operating condition • Wall construction • Size 	Ensure that work space is safe and ready for glass replacement Verify scope of work
3.1202.3b	Lead paint assessment	Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file EPA's Renovation, Repair and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards	Protect worker and occupant from potential lead hazards
3.1202.3c	Broken glass removal	Damaged glass will be removed	Safely remove old glass
3.1202.3d	Opening preparation	Opening will be cleaned Original sealant/material will be removed	Prepare opening for new glass

3.1202.3e	New glass installation	<p>Replacement glass will be sized to original width, height, and depth</p> <p>Stops will be replaced or installed</p> <p>Glass will be sealed in accordance with original installation design</p> <p>Glass will be selected with comparable tint and coating (color and look) Tempered or safety glass will be used as required by local code</p>	Install, seal, and secure new glass in place
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Replacing Manufactured Housing Windows and doors			
3.1203.3a	Work assessment	<p>Installer prework assessment will be conducted to determine:</p> <ul style="list-style-type: none"> • Number • Type • Operating condition • Wall construction 	<p>Ensure work space is safe and ready for air sealing</p> <p>Verify scope of work</p>
3.1203.3b	Lead paint assessment	<p>Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file</p> <p>EPA's Renovation, Repair and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards</p>	Protect worker and occupant from potential lead hazards
3.1203.3c	Window or door selection	<p>Window or door units will be designed for manufactured home use and will be ENERGY STAR qualified</p> <p>Rough opening will be measured before ordering replacements</p> <p>Access to emergency egress points, such as primary windows or exit doors, will be considered during the selection of retrofit window or door units</p>	Ensure proper size, type, and operation of window or door
3.1203.3d	Rough opening preparation	<p>Existing units will be removed</p> <p>Opening will be cleaned</p> <p>Any damaged framing will be replaced</p> <p>Opening for installation will be prepared in accordance with manufacturer specifications</p>	Provide a clean opening for replacement unit
3.1203.3e	Window and door installation	Window or door units will be installed in accordance with manufacturer specifications	<p>Ensure replacement window or door operates properly</p> <p>Ensure replacement window or door has a weathertight fit</p>
3.1203.3f	Safety	Egress windows will only be replaced with egress windows	Provide safe egress for occupants
3.1203.3g	Maintenance and occupant education	Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain window or door	Ensure long-term weathertightness

Appendix A to Part 440 - Standards for Weatherization Materials

If the standards listed in this appendix conflict with those required by current local codes, the local code shall have precedence and a copy of the applicable section will be retained with procurement records.

The following Government standards are produced by the Consumer Product Safety Commission and are published in title 16, Code of Federal Regulations:

Thermal Insulating Materials for Building Elements Including Walls, Floors, Ceilings, Attics, and Roofs Insulation—organic fiber—conformance to Interim Safety Standard in 16 CFR part 1209;

Fire Safety Requirements for Thermal Insulating Materials According to Insulation Use—Attic Floor—insulation materials intended for exposed use in attic floors shall be capable of meeting the same flammability requirements given for cellulose insulation in 16 CFR part 1209;

Enclosed spaces—insulation materials intended for use within enclosed stud or joist spaces shall be capable of meeting smoldering combustion requirements in 16 CFR part 1209.

The following standards which are not otherwise set forth in part 440 are incorporated by reference and made part of part 440. The following standards have been approved for incorporation by reference by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. These materials are incorporated as they exist on January 3, 2002 and a notice of any change in these materials will be published in the FEDERAL REGISTER. The standards incorporated by reference are available for inspection at the Office of the Federal Register Information Center, 800 North Capitol Street, Suite 700, Washington, DC 20001.

The standards incorporated by reference in part 440 can be obtained from the following sources:

Air Conditioning and Refrigeration Institute, 4301 N. Fairfax Drive, Suite 425, Arlington, VA 22203; (703) 524-8800; www.ari.org.

American Architectural Manufacturers Association, 1827 Walden Office Square, Suite 104, Schaumburg, Illinois 60173-4268; (847) 303-5664; www.aamanet.org.

American Gas Association, 400 N. Capitol Street, NW, Washington, DC 20001; (202) 824-7000; www.aga.org.

American National Standards Institute, Inc., 11 West 42nd Street, New York, NY 10036; (212) 642-4900; www.ansi.org.

American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990; (212) 591-7722; www.asme.org.

American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959; (610) 832-9585; www.astm.org.

Association of Home Appliance Manufacturers, 1111 19th Street, NW, Suite 402, Washington DC, 20036; (202) 872-5955; www.aham.org.

Federal Specifications, General Services Administration, General Services Administration, Federal Supply Service, Office of the CIO and Marketing Division, Room 800, 1941 Jefferson Davis Hwy., Arlington, VA 22202; (703) 305-6288; www.gsa.gov.

Gas Appliance Manufacturers Association, 2107 Wilson Boulevard, Suite 600, Arlington, Virginia 22201; (703) 525-7060 www.gamanet.org.

National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209; (703) 841-3200; www.nema.org.

National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101; (617) 770-3000; www.nfpa.org.

Sheet Metal and Air Conditioning Contractors Association, 4201 Lafayette Center Drive, Chantilly, Virginia 20151-1209; (703) 803-2980; www.smacna.org.

Solar Rating and Certification Corporation, c/o FSEC, 1679 Clearlake Road, Cocoa, FL 32922-5703; (321) 638-1537; www.solar-rating.org.

Steel Door Institute, 30200 Detroit Road, Cleveland, OH 44145-1967; (440) 899-0010; www.steeldoor.org.

Steel Window Institute, 1300 Sumner Avenue, Cleveland, OH 44115-2851; (216) 241-7333; www.steelwindows.com.

Tubular Exchanger Manufacturers Association, 25 North Broadway, Tarrytown, NY 10591; (914) 322-0040; www.tema.org.

Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096; (847) 272-8800; www.ul.com.

Window & Door Manufacturers Association, 1400 East Touhy Avenue, Suite 470, Des Plaines, IL 60018; (800) 223-2301; www.nwwda.org.

More information regarding the standards in this reference can be obtained from the following sources:

Environmental Protection Agency, 401 M Street, NW, Washington, DC 20006; (202) 554-1080; www.epa.gov.

National Institute of Standards and Technology, U.S. Department of Commerce, Gaithersburg, MD 20899; (301) 975-2000; www.nist.gov.

Weatherization Assistance Program, Office of Building Technology Assistance, Energy Efficiency and Renewable Energy, 1000 Independence Avenue, SW, EE-42, Washington, DC 20585-0121; (202) 586-4074; www.eere.energy.gov/weatherization.

THERMAL INSULATING MATERIALS FOR BUILDING ELEMENTS INCLUDING WALLS, FLOORS, CEILINGS, ATTICS, AND ROOFS

[Standards for conformance]

Insulation--mineral fiber:	
Blanket insulation	ASTM ¹ C665-01e1.
	ASTM C726-05.
Roof insulation board	ASTM C764-04.
Loose-fill insulation	

Insulation--mineral cellular:	ASTM C516-02.
Vermiculite loose-fill insulation	ASTM C549-02.
Perlite loose-fill insulation.....	ASTM C552-03.
Cellular glass insulation block	ASTM C728-05.
Perlite insulation board	
Insulation--organic fiber:	
Cellulosic fiber insulating board ..	ASTM C208-95 (2001).
Cellulose loose-fill insulation	ASTM C739-03e1.
	ASTM C1149-02 or
Cellulose wet-spray insulation	ASTM C1497-04.
Insulation--organic cellular:	ASTM C578-05.
Preformed block-type	
polystyrene insulation	ASTM C591-01.
Rigid preformed poly-urethane	
insulation board	
Faced rigid cellular poly-	ASTM C1289-05.
urethane or polyiso-cyanurate	
insulation board	ASTM C1029-05.
Spray-applied rigid cellular	
polyurethane insulation	
Spray-applied bio-based	ASTM C1029-05, as
polyurethane semi-open	amended by Table
celled insulation	2 of ICC ² AC12.
	ASTM C726-05.
	ASTM C728-05.
Insulation--composite boards:	
Mineral fiber insulation board.....	
Perlite board.....	ASTM C1289-05.
Gypsum board and poly-	
urethane or polyisocyanurate	
composite board	Commercially
Materials used as a patch to	available.
reduce infiltration through the	
building envelope	

¹ ASTM indicates American Society for Testing and Materials.

² ICC indicates International Code Council.

THERMAL INSULATING MATERIALS FOR PIPES, DUCTS, AND EQUIPMENT SUCH AS BOILERS AND FURNACES

[Standards for conformance]

Insulation--mineral fiber:	
Preformed pipe insulation.....	ASTM ¹ C547-03.
Blanket and felt insulation	
(industrial type)	ASTM C553-02.
Glass fiber felt insulation.....	ASTM C1086-96 (2004).
Blanket insulation and blanket	
type pipe insulation (metal-	
mesh covered, industrial type)	
.....	ASTM C592-04.
Block and board insulation	ASTM C612-04.
Spray applied mineral fiber	
thermal and sound absorbing	
insulation	ASTM C1014-03.
High-temperature fiber blanket	
insulation	ASTM C892-00.
Duct work insulation	ASTM C1290-00.
Insulation--mineral cellular:	
Calcium silicate block and pipe	
insulation	ASTM C533-95.
Cellular glass insulation	ASTM C552-00.
Expanded perlite block and pipe	
insulation	ASTM C610-99.
Insulation--organic cellular:	
Preformed flexible elastomeric	
cellular insulation in sheet and	
tubular form	
Unfaced preformed rigid cellular	ASTM C534-99.
polyurethane insulation	
Foil-faced flexible polyethylene	
sheet insulation	ASTM C591-00.
Insulation skirting.....	ASTM C1224-03.
	Commercially
	available.

¹ ASTM indicates American Society for Testing and Materials.

FIRE SAFETY REQUIREMENTS FOR INSULATING MATERIALS ACCORDING TO INSULATION USE

[Standards for conformance]

Attic floor	Insulation materials intended for exposed use in attic floors shall be capable of meeting the same smoldering combustion requirements given for cellulose insulation in ASTM ¹ C739-03e1.
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¹ ASTM indicates American Society for Testing and Materials.

**FIRE SAFETY REQUIREMENTS FOR INSULATING MATERIALS
ACCORDING TO INSULATION USE
Continued**

[Standards for conformance]

Enclosed space	Insulation materials intended for use within enclosed stud or joist spaces shall be capable of meeting the same smoldering combustion requirements given for cellulose insulation in ASTM ¹ C739-03e1.
Exposed interior walls and ceilings	Insulation materials, including those with combustible facings, which remain exposed and serve as wall or ceiling interior finish, shall have a flame spread classification not to exceed 150 (per ASTM E84-05).
Exterior envelope walls and roofs	Exterior envelope walls and roofs containing thermal insulation shall meet applicable local government building code requirements for the complete wall or roof assembly.
Pipes, ducts, and equipment	Insulation materials intended for use on pipes, ducts, and equipment shall be capable of meeting a flame spread classification not to exceed 150 (per ASTM E84-05).

¹ ASTM indicates American Society for Testing and Materials.

STORM WINDOWS

[Standards for conformance]

Storm windows:	
All storm windows.....	AAMA/NWWDA ¹ 101/I.S. 2-97.
Aluminum frame storm windows	AAMA ² 1002.10-93.
Rigid vinyl frame storm windows	ASTM ³ D4726-02.
Frameless plastic glazing storm	Required minimum thickness for windows is 6 mil (0.006 inches).
Movable insulation systems for windows.....	Commercially available.

¹ AAMA/NWWDA indicates American Architectural Manufacturers Association/National Wood Window & Door Association (now the Window & Door Manufacturers Association).

² AAMA indicates American Architectural Manufacturers Association.

³ ASTM indicates American Society for Testing and Materials.

REPLACEMENT WINDOWS

[Standards for conformance]

Replacement windows:	
All windows	AAMA/NWWDA ¹ 101/I.S. 2-97.
Steel frame windows.....	Steel Window Institute recommended specifications for steel windows, Dec 2002.
Rigid vinyl frame windows	ASTM ² D4726-02

¹ AAMA/NWWDA indicates American Architectural Manufacturers Association/National Wood Window & Door Association (now the Window & Door Manufacturers Association).

² ASTM indicates American Society for Testing and Materials.

STORM DOORS

[Standards for conformance]

Storm doors:	
All storm (glass) doors.....	AAMA/NWWDA ¹ 101/I.S. 2-97.
Aluminum frame storm doors	AAMA ² 1102.7-89.
Sliding glass storm doors....	AAMA 1002.10-93.
Rigid vinyl storm doors.....	ASTM ³ D3678-97 (2001) and D4726-02.
Vestibules:	
Materials to construct vestibules	Commercially available.

¹ AAMA/NWWDA indicates American Architectural Manufacturers Association/National Wood Window & Door Association (now the Window & Door Manufacturers Association).

² AAMA indicates American Architectural Manufacturers Association.

³ ASTM indicates American Society for Testing and Materials.

REPLACEMENT DOORS

[Standards for conformance]

Replacement doors:

All replacement doors	AAMA/NWWDA ¹ 101/I.S. 2-97.
Steel doors	ANSI ² A250.8-03.
Wood doors:	
Flush doors	ANSI/NWWDA ³ I.S. 1-97 (Amendment, exterior door provisions).
Stile and rail doors	NWWDA ⁴ I.S. 6-97.

¹ AAMA/NWWDA indicates American Architectural Manufacturers Association/National Wood Window & Door Association (now the Window & Door Manufacturers Association).

² ANSI indicates American National Standards Institute.

³ ANSI/NWWDA indicates American National Standards Institute/National Wood Window & Door Association (now the Window & Door Manufacturers Association).

⁴ NWWDA indicates National Wood Window & Door Association (now the Window & Door Manufacturers Association).

CAULKS AND SEALANTS

[Standards for conformance]

Caulks and sealants:

Glazing compounds for metal sash	Commercially available.
Oil and resin base caulks	Commercially available.
Acrylic (solvent type) sealants	ASTM C920-05.
Butyl rubber sealants	FS ² Commercial Item Description A-A-272 (10/19/99).
Chlorosulfonated polyethylene sealants	ASTM C920-05.
Latex sealing compounds ...	ASTM C834-05.
Elastomeric joint sealants (normally considered to include polysulfide, polyurethane, and silicone) ...	ASTM C920-05.
Preformed gaskets and sealing materials	ASTM C509-00.
Duct sealing mastic	UL ³ 181A, Third Edition, 2005 and UL 181B, Second Edition, 2005.

¹ ASTM indicates American Society for Testing and Materials.

² FS indicates Federal Specifications.

³ UL indicates Underwriters Laboratories.

WEATHERSTRIPPING

[Standards for conformance]

Weatherstripping	Commercially available.
Door sweeps	Commercially available.
Vapor retarders	Selected according to the provisions cited in ASTM ¹ C755-03. Permeance not greater than 1 perm when determined according to the desiccant method described in ASTM E96-00e1.
Items to improve attic ventilation	Commercially available.

¹ ASTM indicates American Society for Testing and Materials.

HEAT EXCHANGERS

[Standards for conformance]

Heat exchangers, water-to-water and steam-to-water	ASME ¹ Boiler and Pressure Vessel Code, 2004, Sections II, V, VIII, IX, and X, as applicable to pressure vessels. Standards of Tubular Exchanger Manufacturers Association, Eighth Edition, 1999.
Heat exchangers with gas-fired appliances ²	ANSI/UL ³ 462, Second Edition, 1993.

¹ ASME indicates American Society for Mechanical Engineers.

² The heat reclaimer is for installation in a section of the vent connector from appliances equipped with draft hoods or appliances equipped with powered burners or induced draft and not equipped with a draft hood.

³ ANSI/UL indicates American National Standards Institute/Underwriters Laboratories.

BOILER/FURNACE CONTROL SYSTEMS

[Standards for conformance]

Automatic set back thermostats	Listed by UL ¹ . Conformance to NEMA ² DC3-2003.
Line voltage or low voltage room thermostats	Listed by UL. Conformance to NEMA DC3-2003.
Clock thermostats	Listed by UL. Conformance to NEMA DC3-2003.
Automatic gas ignition systems	ANSI ³ Z21.21-2001. AGA ⁴ Laboratories Certification Seal.
Energy management systems	Listed by UL.
Hydronic boiler controls	Listed by UL.
Other burner controls	Listed by UL.

¹ UL indicates Underwriters Laboratories.

² NEMA indicates National Electrical Manufacturers Association.

³ ANSI indicates American National Standards Institute.

⁴ AGA indicates American Gas Association.

WATER HEATER MODIFICATIONS

[Standards for conformance]

Insulate tank and distribution piping	(See insulation section of this appendix)
Install heat traps on inlet and outlet piping	Applicable local plumbing code.
Install/replace water heater heating elements	
Electric, freeze-prevention tape for pipes	Listed by UL ¹ .
Install stack damper, gas-fueled	Listed by UL.
	ANSI ² Z21.66-1996, including Exhibits A & B, and ANSI Z223.1-2003 (same as NFPA ³ 54-2002 and International Fuel Gas Code -2003).

¹ UL indicates Underwriters Laboratories.

² ANSI indicates American National Standards Institute.

³ NFPA indicates National Fire Prevention Association.

WATER HEATER MODIFICATIONS

Continued

[Standards for conformance]

Install stack damper, oil-fueled	UL ¹ 17, Third Edition, 1994, NFPA ² 31-2001, NFPA 211-2003 (same as ANSI ³ A52.1), and ANSI/ NFPA 70-2005 (same as IEEE ⁴ National Electrical Code).
Install water flow modifiers	Commercially available.

¹ UL indicates Underwriters Laboratories.

² NFPA indicates National Fire Prevention Association.

³ ANSI indicates American National Standards Institute.

⁴ IEEE indicates Institute of Electrical and Electronics Engineers.

REPLACEMENT WATER HEATERS

[Standards for conformance]

Electric (resistance) water heaters	10 CFR ¹ 430 and UL ³ 174.
Heat pump water heaters ..	UL 1995, Third Edition, 2005. Electrical components to be listed by UL.
Gas water heaters:	
Rated ≤75 kBtu/hr	10 CFR 430 and ANSI ⁴ Z21.10.1-2005.
Rated >75 kBtu/hr	ANSI Z21.10.3-2004.
Oil water heaters	UL 732, Fifth Edition, 1995.

¹ CFR indicates Code of Federal Regulations.

² UL indicates Underwriters Laboratories.

³ ANSI indicates American National Standards Institute.

SOLAR WATER HEATING SYSTEMS¹

[Standards for conformance]

Solar water heating systems including forced circulation, integral collector storage, thermo-syphon, and self-pumping systems	System must be certified per SRCC ² OG 300, May 2002.
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¹ Solar water heating systems for weatherization-eligible households should be hybrid systems with a back-up source of hot water.

² SRCC indicates Solar Rating and Certification Corporation.

WASTE HEAT RECOVERY DEVICES

[Standards for conformance]

Desuperheater/water heaters	ARI ¹ 470-2001 and UL 1995, Third Edition, 2005.
Condensing heat exchangers	Commercially available components installed per manufacturers' specifications. NFPA ² 211-2003 (same as ANSI A52.1) may apply in certain instances. See also the Heat Exchangers section of this appendix.
Heat pump water heating heat recovery systems...	UL 1995, Third Edition, 2005. Electrical components to be listed by UL.
Energy recovery equipment	Energy Systems Analysis and Management, 1997 (SMACNA ³).

¹ ARI indicates Air Conditioning and Refrigeration Institute.

² NFPA indicates National Fire Prevention Association.

³ SMACNA denotes Sheet Metal and Air Conditioning Contractors' National Association.

BOILER REPAIR AND MODIFICATIONS/ EFFICIENCY IMPROVEMENTS

[Standards for conformance]

Install gas conversion burners	ANSI ¹ Z21.8-1994 (for gas- or oil-fired systems), ANSI Z21.17-1998, and ANSI Z223.1-2003 (same as NFPA ² 54-2002 and International Fuel Gas Code). AGA ³ Laboratories Certification Seal.
Replace oil burner	UL ⁴ 296, Tenth Edition, 2003 and NFPA 31-2001. ANSI Z223.1-2003 for gas equipment and NFPA 31-2001 for oil equipment.
Install burners (oil/gas)	

¹ ANSI indicates American National Standards Institute.

² NFPA indicates National Fire Prevention Association.

³ AGA indicates American Gas Association.

⁴ UL indicates Underwriters Laboratories.

BOILER REPAIR AND MODIFICATIONS/ EFFICIENCY IMPROVEMENTS—Continued

[Standards for conformance]

Re-adjust boiler water temperature or install automatic boiler temperature reset control	ASME ¹ CSD-1-2004, ANSI ² Z223.1-2003, and NFPA ³ 31-2001.
Replace/modify boilers	ASME Boiler and Pressure Vessel Code, 2004, Section II, IV, V, VI, VIII, IX, and X. Boilers must be Hydronics Institute Division of GAMA ⁴ equipment.
Clean heat exchanger, adjust burner air shutter(s), check smoke no. on oil-fueled equipment. Check operation of pump(s) and replacement filters ..	Per manufacturers' instructions.
Replace combustion chambers	Refractory linings may be required for conversions.
Replace heat ex-changers, tubes	Protection from flame contact with conversion burners by refractory shield.
Install/replace thermo-static radiator valves	Commercially available. One-pipe steam systems require air vents on each radiator; see manufacturers' requirements.
Install boiler duty cycle control system	Commercially available. ANSI/NFPA 70-2005 (same as IEEE ⁵ National Electrical Code) and local electrical code provisions for wiring.

¹ ASME indicates American Society for Mechanical Engineers

² ANSI indicates American National Standards Institute.

³ NFPA indicates National Fire Prevention Association.

⁴ GAMA indicates Gas Appliance Manufacturers Association.

⁵ IEEE indicates Institute of Electrical and Electronics Engineers.

HEATING AND COOLING SYSTEM REPAIRS AND TUNE-UPS/EFFICIENCY IMPROVEMENTS

[Standards for conformance]

Install duct insulation	ASTM ¹ C612-04 (see insulation sections of this appendix).
Reduce Input of burner; derate gas-fueled equipment	Local utility company and procedures if applicable for gas-fueled furnaces and ANSI ² Z223.1-2003 (same as NFPA ³ 54-2002) including Appendix H.
Repair/replace oil-fired equipment	NFPA 31-2001.
Replace combustion chamber in oil-fired furnaces or boilers	NFPA 31-2001.
Clean heat exchanger and adjust burner; adjust air shutter and check CO ₂ and stack temperature. Clean or replace air filter on forced air furnace	ANSI Z223.1-2003 (same as NFPA 54-2002) including Appendix H.
Install vent dampers for gas-fueled heating systems	Applicable sections of ANSI Z223.1-2003 (same as NFPA 54-2002) including Appendix H, I, J, and K. ANSI Z21.66-1996 and Exhibits A&B for electrically operated dampers.
Install vent dampers for oil-fueled heating systems...	Applicable sections of NFPA 31-2001 for installation and in conformance with UL ⁴ 17, Third Edition, 1994.

¹ ASTM indicates American Society for Testing and Materials.

² ANSI indicates American National Standards Institute.

³ NFPA indicates National Fire Prevention Association.

⁴ UL indicates Underwriters Laboratories.

HEATING AND COOLING SYSTEM REPAIRS AND TUNE-UPS/EFFICIENCY IMPROVEMENTS—Continued

[Standards for conformance]

Reduce excess combustion air: A: Reduce vent connector size of gas-fueled appliances	ANSI ¹ Z223.1-2003 (same as NFPA ² 54-2002) Part 9 and Appendices G&H.
B: Adjust barometric draft regulator for oil fuels	NFPA 31-2001 and per furnace and boiler manufacturers' instructions.
Replace constant burning pilot with electronic ignition device on gas-fueled furnaces or boilers	ANSI Z21.71-2005.
Readjust fan switch on forced air gas- or oil-fueled furnaces	Applicable sections on Appendix H of ANSI Z223.1-2003 (same as NFPA 31-2002) for gas furnaces and NFPA 31-2001 for oil furnaces. See install burners (oil/gas).
Replace burners	ANSI Z223.1-2003 (same as NFPA 31-2002).
Install/replace duct furnaces (gas)	ARI ³ 210/240-2003. UL ⁴ 1995 Third Edition, 2005.
Install/replace heat pumps	Commercially available.
Replace air diffusers, intakes, registers, and grilles	UL 181, Tenth Edition 2005, including UL 181A, Third Edition 2005 and 181B, Second Edition, 2005. Commercially available.
Install/replace warm air heating metal ducts	
Filter alarm unit	

¹ ANSI indicates American National Standards Institute.

² NFPA indicates National Fire Prevention Association.

³ ARI indicates Air-Conditioning and Refrigeration Institute.

⁴ UL indicates Underwriters Laboratories.

REPLACEMENT FURNACES, BOILERS, AND WOOD STOVES

[Standards for conformance]

Chimneys, fireplaces, vents and solid fuel burning appliances	NFPA ¹ 211-2003 (same as ANSI ² A52.1).
Gas-fired furnaces	ANSI Z21.47-2004 and ANSI Z223.1-2003 (same as NFPA 54-2002).
Oil-fired furnaces	UL ³ 727, Eighth Edition, 1994 and NFPA 31-2001.
Liquefied petroleum gas storage	NFPA 58-2004.
Ventilation fans: Including electric attic, ceiling, and whole-house fans	UL 507, Ninth Edition, 1999.

¹ NFPA indicates National Fire Prevention Association.

² ANSI indicates American National Standards Institute.

³ UL indicates Underwriters Laboratories.

ELECTRIC MOTORS AND MOTOR CONTROLS

[Standards for conformance]

All electric motors	UL ¹ 1004, Fifth Edition, 1994.
Variable-speed drives	Listed by UL.

¹ UL indicates Underwriters Laboratories.

AIR CONDITIONERS AND COOLING EQUIPMENT

[Standards for conformance]

Air conditioners:	
Central air conditioners	ARI ¹ 210/240-2003.
Room size units	ANSI/AHAM ² RAC 1-2003.
Other cooling equipment: Including evaporative coolers, heat pumps, and other equipment	UL ³ 1995, Third Edition, 2005.

¹ ARI indicates Air Conditioning and Refrigeration Institute.

² ANSI/AHAM indicates American National Standards Institute/Association of Home Appliance Manufacturers.

³ UL indicates Underwriters Laboratories.

SCREENS, WINDOW FILMS, AND REFLECTIVE MATERIALS

[Standards for conformance]

Insect screens	Commercially available.
Window films	Commercially available.
Shade screens:	
Fiberglass shade screens	Commercially available.
Polyester shade screens	Commercially available.
Rigid awnings:	
Wood rigid awnings	Commercially available.
Metal rigid awnings	Commercially available.
Louver systems:	
Wood louver awnings	Energy Star criteria for reflective roof products.
Metal louver awnings	
Reflective roof coating	

REFRIGERATORS

[Standards for conformance]

Refrigerator/freezers (does not include freezer-only units)	UL ¹ 250. Replaced units must be disposed of properly per Clean Air Act 1990, Section 608, as amended by 40 CFR ² 82, May 14, 1993.
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¹ UL indicates Underwriters Laboratories.

² CFR indicates Code of Federal Regulations.

FLUORESCENT LAMPS AND FIXTURES

[Standards for conformance]

Compact fluorescent lamps	ANSI/UL ¹ 542, Eighth Edition, 1999, and UL 1993, First Edition, 1993.
Fluorescent lighting fixtures	UL 1598, Second Edition, 2004.

¹ ANSI/UL indicates American National Standards Institute/Underwriters Laboratories.